CHEDDAR CHEESE MAKING

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HIRAM SMITH HALL — WISCONSIN DAIRY SCHOOL BUILDING.

CHEDDAR

CHEESE MAKING

BY

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PRICE $1.00

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PREFACE

In the past five years great advances have been made in cheese-making, and for the old rule of thumb definite scientific reasons have been substituted.

During the brief history of the Wisconsin Dairy School, the theoretical part of the instruction in cheese-making has been given by a series of lectures and quizzes along with the practical work.

All books treating on cheese-making are either out of date because of the rapid advance in knowledge on the subject, or are unfitted for use as text books in a school.

The instructor has learned from experience that in order to have students properly grasp the subject before them, it must not only be presented by lectures and quizzes, but the student must have it before him in some tangible form like a text book. In lectures, too much is given for students to fix in their minds at first hearing, and therefore a text book will greatly increase the efficiency of the work done in the school.

There are also other cheese-makers, who are not students in dairy schools, but who are seeking for more light in their business, and it is hoped that they may here find information that will be helpful to them.

How well the book will meet the needs for which it was written time alone will demonstrate. Only a small edition of the book has been printed, as it has been

hurriedly written under pressure of other work; it is hoped, however, that it will meet the primary object for which it was written, that of serving as an aid in cheese-making rather than as a complete treatise on the subject.

Part I deals with the fermentations of milk and the process of making.

Part II deals with the construction and operation of factories.

Part III consists of questions which are answered in parts I and II. The page on which the answer to the question may be found is indicated at the end of the question. Important points are indicated by paragraph headings and usually the answer to the question can be immediately found by glancing at these.

The writer believes that the questions in Part III will not only be helpful to students of dairy schools in mastering the subject, but that they will also be of aid to all students of cheese-making.

A careful study of the questions is urged, however simple they may seem, as an accurate knowledge of the details and the reasons why, of the various steps in the process is absolutely necessary in order to master the profession.

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CHAPTER I.

MILK.

Composition of Milk. Milk is a secretion of mammals for the nourishment of their young. If we examine the milks of different mammals, we will find that they are composed of the same substances, but that these substances vary in their proportions, as will be seen from the following table giving the composition of milks from different origins:

	Human.	Cow.	Mare.	Goat.	Ewe.	Sow
Albuminoids (protein compound)	2.5	4.1	1.7	5.0	4.5	6.2
Fat	3.6	4.0	.8	3.7	4.2	5.8
Milk Sugar	6.5	4.2	8.8	4.5	5.0	5.3
Ash (chiefly Phosphates)	.5	.7	.4	.6	.7	.9
Total solids	13.1	13.0	11.7	13.8	14.4	18.2
Water	86.9	87.0	88.3	86.2	85.6	81.8

As American cheese is made from cows' milk only, no consideration will be given any of the other kinds of milk.

That we may have a better idea of milk, let us look at the nature of the substances in its composition.

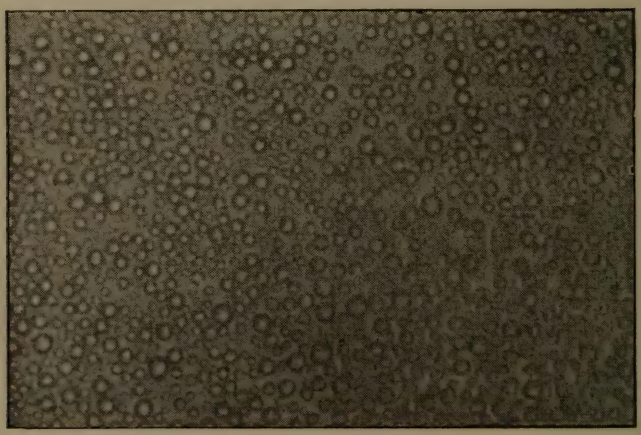
Albuminoids. The albuminoids or protein compounds contain about sixteen per cent. of nitrogen, and are the muscle forming part of the milk.

Milk Sugar. The sugar of milk crystallizes in hard crystals, which are neither as soluble nor as sweet as cane or ordinary sugar. Commercial milk sugar is used largely in the manufacture of lactated foods.

Ash. The ash is the mineral substance left when milk is burned. Chemical analysis shows it to consist largely of phosphates. The ash is the bone-forming part of the milk.

Water. The albuminoids,* milk sugar and ash are all in solution in the eighty-seven per cent. of water.

Fat. The fat of the milk is not in solution, but in the form of little globules suspended in the liquid portion, which form is called an emulsion.



MICROSCOPIC MILK AS DRAWN FROM THE COW.

The globules vary in size from one two-thousandth to one ten-thousandth of an inch in diameter. By one ten-thousandth of an inch is meant that it would take ten thousand of these little globules placed side by side to make a row an inch long.

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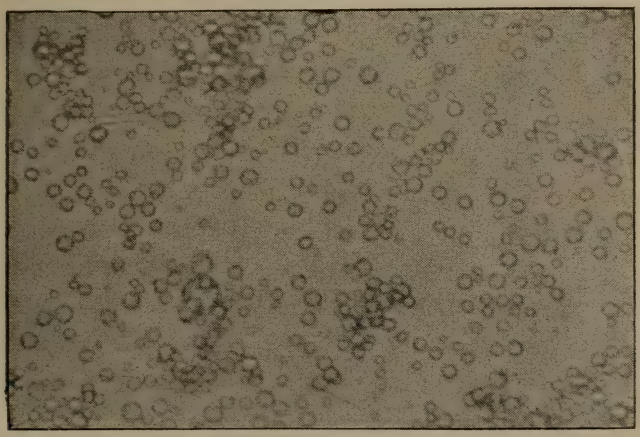
*The casein, which is an albuminoid, is thought by some authorities not to be in solution, but in the form of a thin gelatinous mass. This point however is disputed, and for all practical purposes we can speak of it as in solution.

Colostrum Milk. The first milk given by a cow just after calving is called colostrum milk, and is much more viscous than normal milk, sometimes being nearly as thick as syrup. The components of the milk are not in their normal proportions, the albuminoids sometimes amounting to fifteen per cent. of the milk, while the fat may be less than two per cent. Under the microscope, cells which have scaled off from the inside of the udder can be seen floating about, and while these dead particles of tissue are in the milk, it is unfit for cheese. After four or five milkings the milk will appear normal, but it should not be used for a week.



MICROSCOPIC MILK AFTER STANDING A SHORT TIME.

When milk is taken into the calf's stomach, it is digested by the juices secreted by the same. If we take a stomach and soak it in water or brine, two ferments, rennet and pepsin, the active principles in digestion, are dissolved; and if we add this solution to

milk, the milk will be curdled. The part of the milk that is curdled is the casein, which is the larger portion of the albuminoids. About one-fourth of the albuminous substance in the milk is like the white of an egg, and is not coagulated by rennet. By heating the whey after the casein has been first coagulated, this part will be precipitated, and therefore seems to be identical with the albumen of an egg, which is also coagulated by heat, as is seen in cooking, and is called lactalbumen.

Whey. In the manufacture of cheese the milk is curdled by rennet, and the curd cut into small pieces from which the liquid portion, or whey, is expelled. The whey then is the major part of the water of the milk, which carries with it nearly all the soluble portions, namely: the albumen, milk sugar, ash, and also a small portion of the fat, as the very small globules break away from the curd in cutting it.

Curd. The curd, or green cheese, is then the coagulated casein which holds in its meshes most of the fat, some water, and small portions of the albumen, milk sugar and ash. The water in green cheese is about one-third of its weight. We look upon green cheese and curd as identical, for green cheese is simply curd pressed together.

Fat Necessary for Cheese. While the casein may be said to be the cheesy part of the milk, still the quantity and quality of the cheese produced is greatly affected by the quantity of fat present in the milk; in fact, the real value of milk for cheese is determined by the amount of fat it contains. Without the fat the

casein will dry out very rapidly and become very hard. The fat not only helps the casein to hold the water from excessive evaporation, but it seems to increase the capacity of it for absorbing water.

CHAPTER II.

THE FERMENTATIONS OF MILK.

Cheese-making a Process of Fermentation. The process of cheese-making is a process of fermentation from beginning to end. It will therefore be necessary to consider the different kinds of ferments, and how they act in the process. There are two general kinds of ferments, namely: organized and unorganized.

Organized Ferments. The organized ferments are so called because they are the result of the growth of minute vegetable organisms. There are millions of these organisms in the milk, and in their growth they decompose the components of the milk, forming varying decomposition products. Nearly all the trouble we have in cheese-making is due to the action of definite living vegetable cells that have the power of manufacturing certain decomposition products; on the other hand, we could not produce fine cheese without the presence of certain forms of bacteria that are able to change the milk, producing the fine desired flavors.

Lactic Ferment. The souring of milk is produced by the growth of certain organized ferments. These organisms so affect the milk sugar that it is changed into lactic acid. When the lactic fermentation is not properly handled and there is too much lactic acid formed in the curd, we have a sour cheese; and on

the other hand when the curd is put to press before the lactic fermentation has run its course, gas is produced, which forms large, round, smooth holes, termed "Swiss holes," so-called because they resemble the holes found in Swiss cheese.

Important Point in Cheese-making. *The most important point in cheese-making is to know how to control the lactic fermentations.*

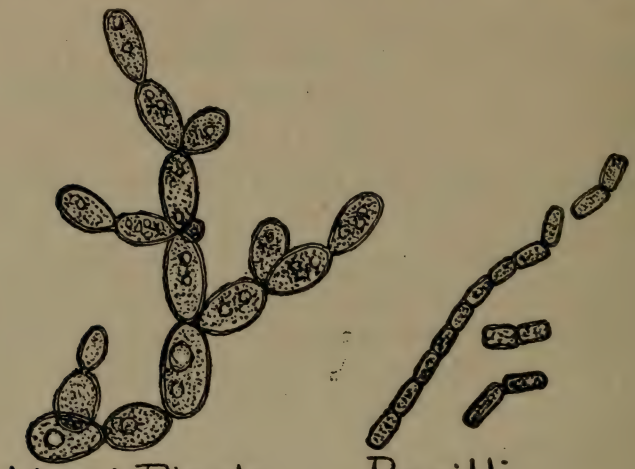
Pinholey Curds due to Bacteria. But the ordinary souring of milk, or lactic fermentation as it is called, is not the only fermentation due to germs or bacteria. Through the action of the lactic ferment the milk sugar is decomposed, but in other fermentations the casein is attacked, and gas formed that collects in little holes about the size of the head of a pin, and such a curd is therefore known as "pinholey."

Butyric Ferment. Bacteriologists have separated quite a number of peculiar ferments that are produced by distinct species of bacteria; for instance, there is the butyric fermentation, in which butyric acid is the decomposition product formed, and the alcoholic fermentation in which alcohol and carbonic acid gas are formed.

Bitter Milk—How Caused. There is also sometimes a bitter taste to milk which usually goes with the butyric fermentation, but bacteriologists have shown it to be the result of a distinct fermentation.

Alkaline Fermentation. Another peculiar fermentation of milk is the alkaline curdling, in which the

milk curdles apparently in the same manner as in ordinary souring, but it shows a distinct alkaline reaction. "Ropy" and "slimy" milk are also fermentations that are brought about by the action of bacteria.



Bacteria. It has been said that these fermentations are due to minute living organisms. They are, in fact, little plants consisting of but a single cell, and these little cells live and grow in a similar way as do larger plants that we can see without a microscope.

On the outside is the cell wall which resembles the shell surrounding an egg. Inside of the cell wall is the protoplasm, or living element of the organism. Some of these single cells are spherical in form, and are known as cocci (singular, coccus), others are rod-like, and are called bacilli (singular, bacillus), meaning a rod, and the yeasts or saccharomyces, which grow in sugar solutions and are oval in form, are still another

class. The protoplasm or living element inside of the cell wall is sensitive to light and heat just as in the higher orders of plants; in fact, these characteristics are the characteristics of life, and anæsthetics, such as chloroform and ether, will cause a cessation of their vital activities, and the fermentation ceases entirely because the protoplasm is killed, or is suspended until the irritating agent is removed.

Difference between Organized and Unorganized Ferments. This is the distinguishing difference between organized and unorganized ferments, the latter class not being affected by anæsthetics. For instance, rennet will curdle milk, and its action is hastened or retarded according to the temperature of the milk, the same as organized ferments, but it is not affected by these protoplasmic poisons.

Rennet is a good representative of the unorganized ferments or enzymes, as they are called, with which we have to deal in cheese-making.

Enzymes. The enzymes do not seem to be living organisms, but are more like a chemical in their action. On the other hand, they hardly seem to be purely chemical, for a chemical will be used up by entering into another combination, but an enzyme may be used over and over again.

Enzymes sometimes produced by Organized Ferments. While enzymes are distinct from organized ferments, they are often produced as a result of the growth of certain organisms. In the alkaline curdling of milk, mentioned among the organized ferments,

there is an enzyme produced as a result of the growth of the bacteria, and then the curdling is accomplished by the enzyme in a manner similar to, if not quite identical with that of rennet. Rennet and pepsin, the active part of the rennet extract used in cheese-making, are both enzymes.

Rennet, where found. Rennet which was first isolated by Hammersten, is found in the stomachs of calves, lambs, and pigs, and also in birds and fishes, and in some plants.

It will be remembered, by referring to the table showing the composition of milk, that there is 0.7 per cent. ash in cows' milk, which is a comparatively small quantity.

Phosphates required. Part of this ash is in the form of phosphates, and though small in quantity, rennet will not curdle the milk without their presence. It is thought that casein forms a chemical combination with the phosphates in a form known as casein tricalcium phosphate, which is soluble, but when rennet is added to the milk, it is changed to calcium phosphate and an insoluble casein compound which is the cheese.

Effect of Salt on Milk. If common salt or magnesium sulphate is added to the milk in sufficient quantity, the casein will be precipitated.

Effect of Heat on Rennet. Rennet will not curdle milk at a very low temperature, but as the temperature is raised it will begin to work, and work faster and faster till at about 130°F. its action is the greatest.

At 170°F. its action ceases, so that it will not curdle milk again.

Rennet does not Exhaust itself. As has been said concerning enzymes, rennet does not seem to spend its energy, but will act over and over again. If we coagulate a quantity of milk, and apply the whey to a like quantity of milk, the milk will be coagulated; we could do this indefinitely, if it were not for getting a larger volume of whey than we have of milk.

Effect of acidity on the Action of Rennet. It has been said that the rapidity in the action of rennet is greatly affected by the temperature of the milk, but we will find, if the temperature of the milk is held constant, the more lactic acid there is in the milk the faster the rennet will act, or if any acid be artificially added to the milk in quantities not sufficient to coagulate it, the action of the rennet will be hastened, and on the other hand if alkali be added to the milk, the action of the rennet will be retarded.

Rennet Extracts not alike. Another cause for varying rapidity of action is the difference in the strength of the rennet extract used. Rennets vary as to the amount of ferment contained in them, and it is next to impossible to get two lots of rennet extract exactly alike.

Rennet is sometimes concentrated in the form of tablets or rennet powder, but even these vary in strength, and they are concentrated to such a degree that it is difficult to measure them closely, and on that account extract is preferable.

What Rennet Extract is. Rennet extract is a solution of rennet and pepsin in strong brine. A rennet, as we buy it on the market, is a calf's stomach, which has been cleaned and filled with salt and allowed to dry. The best rennets come from Bavaria.

How Rennet Extract is Made. Rennet extract is made in the following manner:

Prepare a sufficient number of rennets, say five hundred, by splitting them open so that the water can get into them. Then take an oak barrel and put the rennets into it, and fill with water until they are well covered.

Possibly the barrel might be nearly filled with water, but we should not have more water than is necessary to dissolve the ferment.

A little salt should be added to the water, say three pounds of salt to one hundred pounds of water. The rennets should be stirred up and pounded every day, to facilitate the solution of the ferment, and at the end of a week the liquid should be drawn off and the rennets wrung out with a clothes wringer. They should be put into water again and soaked for another week, and the same operation gone through with. As a usual thing, the ferment has not all been extracted from the stomachs till they have been soaked for four weeks. The liquid that has been obtained by soaking the rennets should be filtered through clean straw, charcoal, and sand, and then an excess of salt added to preserve it.

The extract should be clear though of a dark color.

The first sign of the decomposition of rennet extract is a muddy appearance.

If extract is ever prepared by the cheese-maker, enough to last the whole season should be made in the spring when the weather is cool, and then it should be kept in a cool place.

Reliable Brands to be preferred. The surest way of getting extract that can be depended on, is to buy some reliable brand of extract, such as Hanson's.

The practice of preparing extract every few days is wrong, as the strength of each new lot will not be like the last, and if used in about the same quantities the cheese will not cure evenly. The use of whey as a solvent for the rennet is wrong for reasons that are obvious after considering the subject of organized ferments.

A comparison of extracts and their relative value, will be taken up after the rennet test has been explained.

CHAPTER III.

THE RENNET TEST.

Cause of Uneven Cheese. Cheese makers have had trouble in getting their cheese even in quality. If the milk came in cold in the morning and the rennet was added to it immediately on warming it up to the proper temperature, the development of acid was retarded; and if they put it to press before sufficient acid had been formed, they would get a sweet flavored cheese full of 'Swiss holes.' If the curd was held in the whey long enough for proper development of acid, the chances were that it would become whey-soaked, and a leaky sour cheese would be formed. Or if the milk was over ripe, it would work too fast and the cheese would be sour.

As early as fifty years ago, in England, the cheese makers began to learn that if milk was cold, they would obtain better results by warming it up to 90°F. and allowing it to ripen before adding the rennet; but while it improved the quality of the cheese, it did not always help them out of the difficulty.

Rennet Action dependent on Three Things. It has been shown that the rapidity with which rennet coagulates milk is dependent on:—

1. The strength of the rennet extract.
2. The temperature of the milk.
3. The acidity of the milk.

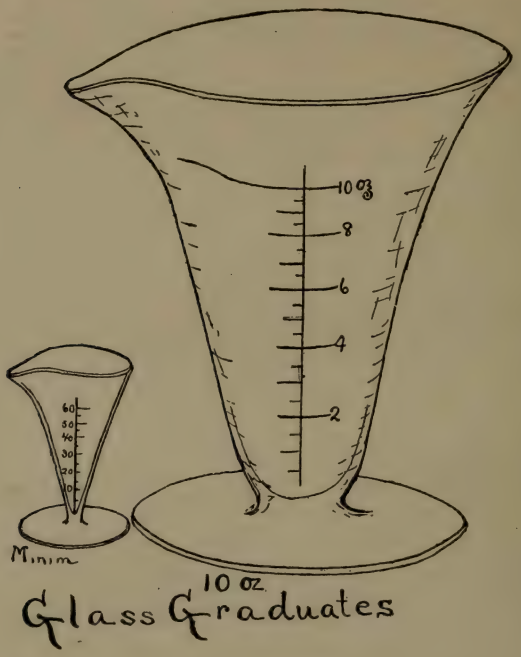
Now if we use the same rennet, at the same temperture of the milk each time, the variation in the rapidity with which it coagulates the milk, must be due solely to the acidity or ripeness of the milk.

J. B. Harris discovers the Rennet Test. About ten years ago J. B. Harris conceived this idea, and used a teacupful of milk from the vat, to which he added a teaspoonful of rennet and noted the number of seconds required to coagulate the milk. When the milk was ripened down to a certain number of seconds, he found that could foretell approximately the time that it would take for acid to develop.

Rennet a Powerful Agent. But if one stops a moment to figure on it, he will see that rennet is a very powerful agent. If one uses four ounces of extract to one thousand pounds of milk, it is one part of rennet to four thousand of milk, and sometimes the proportion will be as wide as one to sixteen thousand. It will be easily seen that since the rennet is such a powerful agent, it is not likely to be an entirely accurate test where a teaspoon is used for measuring the rennet, for then it would be difficult to measure exactly twice alike. Therefore, in place of the teaspoon, a minim or dram graduate was substituted, and for the tea cup an eight ounce glass graduate such as druggists use. This was much better than the other crude apparatus for making the test.

Glass Graduates for Measuring. But the minim graduate is funnel shaped, and the top being broad in proportion to its volume, the chances for error are

still too great in measuring. In actual practice, through haste in making the test, two or three drops of extract were likely to be left in the narrow bot-

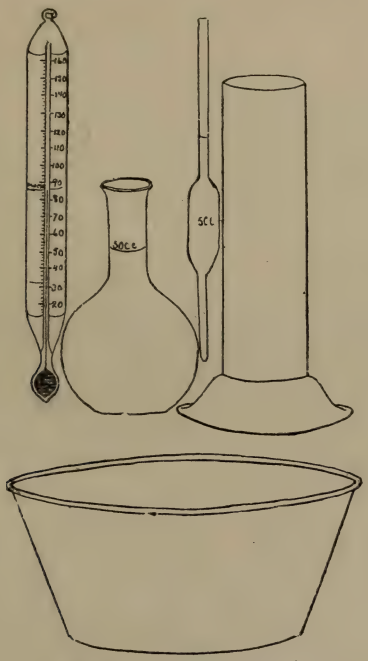


tom of the minim graduate, and the maker would be confused in not getting the results he expected by depending on it.

J. H. Monrad then proposed a new set of apparatus, which, though not so simple, leaves less chance for error.

The Monrad Rennet Test. The apparatus for the Monrad test, as used at the Wisconsin dairy school, consists of a 160c.c. tin cylinder for measuring the

milk, a 5c.c. pipette, a 50c.c. glass flask, and a half pint tin basin. By filling the tin cylinder full it always gives the right measure of milk quickly. Measuring the milk in a glass graduate is difficult, as it is hard to get the milk just to the mark, and if the glass is covered with white milk it is difficult to see the mark.



MONRAD RENNET TEST.

The rennet is first measured with the 5c.c. pipette. A pipette (as will be seen by reference to the illustration), is a glass tube with a mark on it indicating the volume of 5c.c., and the rennet can very easily be measured to the mark, and the tube being narrow makes the measurement accurate. The rennet in the

pipette is delivered into the 50c.c. flask, and what little rennet adheres to the inside of the pipette is rinsed into the flask. This is then filled with water to the 50c.c. mark on the neck, and the solution mixed by shaking. The milk, the temperature of which should be 86° F., measured in the tin cylinder, is emptied into the half pint basin, and 5c.c. of the dilute extract is measured into the 160c.c. of milk, and the number of seconds required to curdle it noted. If a few specks of charcoal are scattered on the milk and the milk started into motion around the dish with a thermometer, the instant of curdling can be noted by the stopping of the specks. They will stop so suddenly as to seem to start back in the opposite direction.

Use Thermometer to Stir Milk. By using a thermometer, the temperature can be constantly watched; and if the temperature should fall, it can quickly be brought back to 86° F. by setting the basin in a pail of warm water for five seconds.

Ripening the Milk. If the milk is ripened so as to coagulate in the same number of seconds each day, one can tell very closely the time when the whey can be drawn off from the curd. It should be ripened to a point where in two hours from the time the rennet is added to the milk there will be one "eighth of an inch of acid" on the curd, as we shall see later on.

With the rennet extract we have been using at the Wisconsin Dairy School, the milk when ripened to thirty seconds works off in about the right time, but the extract is very strong, one ounce being sufficient

to coagulate one thousand pounds of milk in twenty minutes. If however our rennet extract was so weak that it would take four ounces of it to coagulate one thousand pounds of the same milk in twenty minutes, it would be only one fourth as strong as the rennet we have been using, and the milk would then have to be ripened so as to coagulate in one hundred and twenty seconds instead of thirty.

How to Ripen Milk to the Right Point. Starting in with the season's work the cheese-maker has nothing to guide him as to the ripeness of the milk, simply because he does not know the strength of the rennet extract at his disposal. The first day he makes cheese, he must make a rennet test of his milk at the time he sets it and then observe how the milk acts. If the milk is too sweet, he can calculate about how much riper it must be to work just right, and in a few days he will have the matter entirely under his control. Cheese-makers should never neglect to use the rennet test, for it enables them to judge definitely the condition of their milk.

When a maker is troubled with tainted milk it is often necessary to ripen a little lower than with good milk, for the bad flavor, as we have already learned, is due to some harmful variety of bacteria which choke out the lactic ferments.

Use of a Starter. In such cases it is well to use a starter to make the lactic ferment overcome the other ferment. (See p. 22.)

Comparisons of Rennet Extracts. Sometimes, as has been previously shown, it will take three or four

ounces of one kind of rennet extract to coagulate one thousand pounds of milk at the same temperature and time, as it would take one ounce of another extract. Perhaps the weaker extract is offered for sale at a lower price. By using the rennet test to compare the two kinds of extract, one can tell their relative values.

How to compare Milks. In comparing two lots of milk, for that is just what we do with the rennet test, we must have all the conditions other than the milk the same; that is, we must use the same extract, at the same temperature every time, and the test will tell us the strength of acidity in the milk.

Now if we want to compare two kinds of rennet extract, we must have all the conditions but the extract the same; that is, we must make the tests at the same temperature, on the same milk, and at the same time, for the milk will be ripening and introducing an error if we wait. When these conditions are followed the test gives us the comparative strength of two kinds of rennet extract, and we can afford to pay for them in proportion to their strength with perhaps a preference for the stronger extract, other things being equal, for the stronger extract will invariably keep better.

An Example in Cost of Extract. Suppose two kinds of extract, A and B, are offered to us and the price of A is $1.50 and B $1.25 per gallon. On making comparative tests of them, we find that A coagulates the milk in thirty seconds and B in fifty seconds. Which extract is the cheaper?

We simply put the problem into an inverse proportion. $30 : 50 :: x : \$1.50$.

The product of the means equals the product of the extremes.

$$50x = \$45.00$$
$$x = .90$$

From which we find that we can afford to pay 90 cents for B extract and $1.25 is too much for it.

Having now seen that all rennet extract is not alike, it is evident that when a cheese-maker says he uses three ounces or four ounces of rennet extract per thousand pounds of milk, he gives no definite information. If he says he uses enough to coagulate his milk at 86°F. in twenty minutes, it is at once clear what he means.

How Strength of Rennet should be Expressed. The strength of rennet should always be spoken of in terms of time and temperature, and not in quantity. For instance; if we want to make a fast curing cheese we should say: "We use enough rennet to coagulate the milk in fifteen to twenty minutes at 86°F."; and if we want to make a slow curing cheese we should say: "Enough to coagulate in thirty to forty minutes at 86°F."

CHAPTER IV.

FIRST STEPS IN CHEESE MAKING.

Stir Milk to Keep Cream down. While the milk is being received it should be stirred in the vat to keep the cream down. As soon as the milk has all been received and the quantity figured up, the steam should be turned on and the milk heated to 86°F., and a rennet test made. If the cheese-maker is suspicious that the milk may be over ripe, he should make a rennet test before the milk in the vat is heated up to 86°F., by taking his sample for the rennet test in the basin in which the test is made and warming it up in a pail of warm water.

If the milk is found to be over ripe, he will have to hurry the process to keep ahead of the fermentation. On the other hand, if he finds the milk very sweet, and that he will have to wait an hour or more for it to ripen down, he should use a starter.

Definition of a Starter. A starter is simply a small quantity of milk in which the lactic fermentation has been allowed to develope, and there are therefore millions upon millions of the desired kinds of bacteria in it, and when these are put into the milk in the vat, they increase very rapidly and hasten the ripening of the milk.

STUDENTS MAKING CHEESE — WISCONSIN DAIRY SCHOOL.

What to use for a Starter. The starter should be saved from some patron's milk from the morning or evening before, and should always be the best flavored milk, for the whole vat will be made like it.

What not to use for a Starter. A starter should not be saved from the vat of milk nor the whey, for the starter will then be likely to contain all sorts of germs, good, bad, and indifferent, and these will all be transmitted from one day's milk to the next ; in fact, a bad disease might be carried through the milk in this way for a whole season. Thick milk may be used for a starter, if one is hard pressed, but it is better not to let the starter get quite thick. If the starter is thick, it should be strained carefully through a cloth strainer, for if clots of thick starter get into the vat of milk, they will not be colored and may leave white specks in the curd.

Milk should be ripened to a point where in two hours from the time the rennet is added to the milk, there will be one-eighth of an inch of acid on the curd. What is meant by an eighth of an inch of acid will be explained further on.

Milk must not be too Ripe. Milk should never be allowed to ripen to a point where it will work too fast. In such cases there will be too great a loss of fat in the whey, and a small yield of cheese.

Setting the Milk. Having gotten our milk into the proper condition we are now ready to set it. It should be set at 86°F. As sometimes happens, the

milk may have accidentally been warmed up to 90°. We should rather set the milk at that temperature than wait to cool it down, for the milk will be ripening while we delay setting it. The only objection to setting milk at 90° is that the curd hardens too fast to cut it conveniently. If it were not for that fact, I see no objection to setting it at 98°.

For a fast curing cheese we should use enough rennet to curdle the milk in fifteen to twenty minutes; and for a slow curing cheese enough to curdle in thirty to forty minutes.

Rennet should be Diluted. The rennet should be diluted, not with milk, (why?) but with a dipperful or pailful of water, and then poured into the vat evenly from one end to the other. The milk should have been thoroughly stirred just previous to adding the rennet, and then the rennet should be thoroughly mixed with the milk. The stirring should be done gently so that the fat will not separate from the milk.

The milk should be kept in motion for several minutes; the surface should then be stirred gently with the bottom of the dipper so that the cream will not rise on the surface, and the milk will set, or coagulate, and hold it down. The movement of the dipper should be kept up for about half the time it takes the milk to coagulate, and then a cover should be put over the vat to keep the surface of the milk from cooling off.

When the Curd is ready to Cut. The curd is ready to cut when it will break clean before the finger. The

index finger is thrust into the curd and pushed along through it about half an inch below the surface. The curd is first split by the thumb, and when the proper firmness is reached it will break as the finger is pushed along. If the break is clean, that is, does not leave milky but clear whey in the break, the curd is ready to cut.

CHAPTER V.

CUTTING THE CURD.

Through the work of heat and rennet the curd contracts and expels the whey. In order that this may be more readily done, we cut the curd into small cubes and raise the temperature. The pieces of curd must be of the same size and shape, so that they may expel the whey evenly.

How to Cut a fast working Curd. When we have a fast working or over ripe curd we cut finer and heat faster than with a normal working curd.

The English cheese-makers used to break the curd, first with their hands, and then with wires, but the curd-knife has entirely superseded that method. There are two forms of knives used in the operation.

Use of Horizontal Curd-Knife. The first is the horizontal knife, which has eighteen or twenty blades. When it is drawn through the length of the vat, it will cut the curd into layers or blankets one half-inch thick, by six inches wide, by the length of the vat long. Care must be taken not to jam the curd, for if it is jammed it will be lost in the whey. The flat sides of the blades should not be forced into the curd to get the knife into a position to cut it, for they will jam the curd in so doing.

How to Insert the Horizontal Knife. The length of the knife is therefore held in a horizontal position,

the upper end of the knife near the handle resting on the top of the end of the vat. The knife is then swung down into the curd, the edges of the blades cutting into the curd and taking a circular course till the

knife has assumed a vertical position parallel with the end of the vat, the lower end of the knife resting on the bottom of the vat. In this movement we have not jammed the curd, but have the knife in a position to move it through the length of the vat and cut the curd into the layers. But these layers are only six inches wide and we will have to cut the whole vat of curd into these layers. Then keeping the knife in the curd we must turn it without breaking the curd, so that we can run the knife to the other end of the vat. Using the side of the knife next to the uncut curd as a center, we turn the knife around through 180° of a circle, and we are ready to carry the knife to the other end of the vat.

How to take the Knife out. When we have cut the vat of the curd all up into blankets, we take the knife out in the reverse order to which it went in.

The horizontal knife is now laid aside and the operation finished with the perpendicular knife. The blades in this knife run in the direction of the longest dimension of the knife.

We do not, like some cheese-makers, wait here for the whey to rise over the curd before finishing the

operation, for the pieces of curd will get out of place, and the curd being harder will not be so easily cut.

How to insert the Perpendicular Knife. We start cutting in the same place as we did with the other knife, inserting it in the curd in the same way, for it has cross braces which are really horizontal blades, and we must avoid jamming the curd with them. We draw the knife over the same course that the other knife went, and we have the curd cut into strips one-half inch square and the length of the vat long.

We then cut cross-wise of the vat, being careful not to jam the curd, and we then have it cut into half inch cubes.

If we are making up slow working milk, this amount of cutting may be enough, but if it is necessary to cut finer, it can be done by cutting alternately lengthwise and crosswise of the vat. The strokes should be much quicker now, as the curd has been getting harder and finer and will pass between the blades, and a quick stroke is therefore necessary to cut it.

Rapidity of Stroke a Factor. When a cheese-maker says he cuts a curd a certain number of times, he does not convey the proper idea, for the rapidity of his strokes is a great factor; and if he cuts lengthwise of the vat six times and crosswise six times, and cuts with a slow motion, the curd may not be cut any finer than if it had been cut only four times each way with a quick stroke.

CHAPTER VI.

HEATING THE CURD.

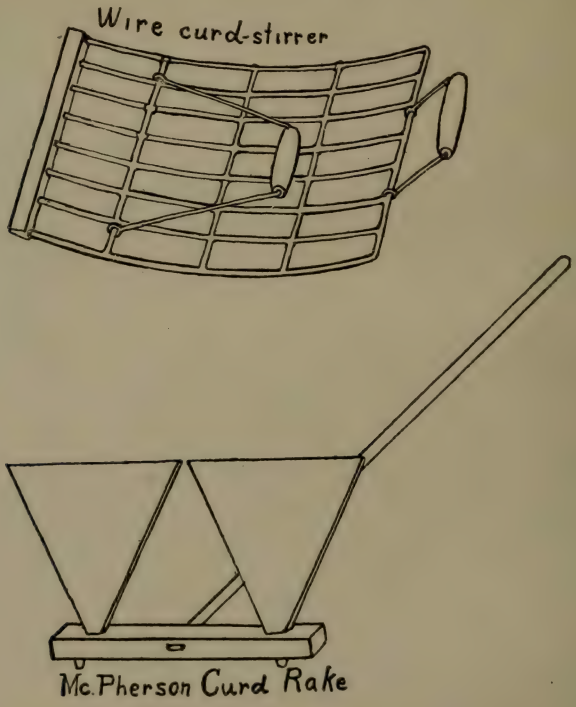
Keep Curd Moving. As has been said, the curd was cut to allow the whey to escape, but if the curd is not kept moving, it will settle to the bottom of the vat and mat together again. Therefore, as soon as the curd has been cut, begin stirring the curd by hand or with a wire basket made for the purpose.

Do not allow the curd to collect in the corners of the vat, and be sure and rub it off from the sides of the vat or it will scald on. The whey should look clear, and be as free as possible from specks of curd floating in it.

When to begin Heating. Curd being a poor conductor of heat, one degree in five minutes is fast enough to heat normal working milk. If it is heated too fast, it will cook the particles on the outside and hold the whey inside of them; and the result will be a mottled whey-soaked cheese. The curd does not expel the whey as fast at 86°F. to 90°F. as it does at a little higher temperature, so that the temperature should be applied slowly at first.

Heating an over ripe Curd. If the milk is over ripe, however, it expels the whey faster, and the curd must be heated faster and higher than normal working curd, or there will be the required amount of acid on the curd before it is hard enough to remove it from

the whey. As a usual thing it is not necessary to cook a curd above ninety-eight degrees, but a curd must be cooked before drawing the whey, no matter if the temperature has to be raised to one hundred and ten degrees to do it. (For definition of cooked curd see p. 33.) It is necessary to cook a fast working



curd in that way, and if the curd is taking acid too rapidly for the heating in the whey to be sufficient to firm the curd before the acid is too great, the whey can be drawn and the remainder of the firming done in warm water, which is run into the vat in place of the whey.

The water dilutes the acid so that it will not have such a bad effect, and at the same time the curd is kept apart and warm so that the whey in it can be thoroughly expelled. It must not be forgotten, however, that an over ripe milk will not yield so well as though it were normal.

"Corky Cheese." If the acid comes too slow, it may not be necessary to cook above 96° F., for if the curd were to be held at 98° for too long a time, too much whey would be expelled, the same as though a normal ripening curd were held at 110° for half an hour. The curd would be too dry and resemble skim-milk curd or sawdust, and the cheese would cure very slowly because of the lack of moisture; it would be said to be "corky" because it resembles cork in texture. If one uses the rennet test carefully, he will know just how fast his curd will work and at what temperature to cook it.

Use Correct Thermometers. It is very essential to have a correct thermometer. The cheap floating thermometers that are usually sold may be five or six degrees wrong. The flange thermometers are not so handy to use in the vat but are more likely to be correct; the glass tube, however, may get loose and slip down the scale giving a misleading temperature. The best way to get a good thermometer is to pay a good fair price, say one or two dollars and buy one that is guaranteed to be correct.

Stirring the Curd. To assist the curd in heating evenly and keep it from matting together, it should be

stirred from the time it is cut till it is cooked. Some Canadian factories have a steam stirring apparatus which is very handy, but in most factories it is done with a rake.

Curd Rakes. There are two kinds of curd rakes in use, the common wooden hay rake and the McPherson curd-rake.

The rake is put into the whey as soon as the steam is turned on, and the curd is started into a rolling motion as though it were boiling. The stirring is commenced with the rake, teeth up, at one end of the vat, and the rake worked down the length of the vat, making the curd roll on the side of the vat opposite the operator; then back again, making the curd roll on the side toward him. Care should be taken that curd does not collect in the corners of the vat; nor should it be allowed to roll up into little balls. On the other hand, it must not be jammed, or fat will be lost in the whey at the expense of the yield of cheese.

McPherson Curd Rake. The McPherson rake has large triangular teeth with the base of the triangle forming the end of the tooth. This form of rake makes it much easier to give the curd a rolling movement. Some rakes have only two large teeth, and others several, but smaller ones. It is well to have two short wooden pins about a half or three-quarters of an inch long, in the back of the rake, to prevent its jamming the curd on the bottom of the vat.

How to tell a Proper Cook. One of the most important steps in the process is to know when a curd is

cooked enough. We should then have one-eighth of an inch of acid on the curd, and draw the whey. Here it will be seen that our judgment comes into play to know how fast to heat a curd, to have it just firm enough when the acid comes. The rennet test will help us to regulate this, but if the rennet test tells us we have a fast working milk, we must cook faster, and perhaps higher. When we draw the whey, the curd must not be salvy and soft, but when a big double handful is pressed together in the hands, and one hand removed, it should not remain in a mashed up mass, but should fall apart readily. The particles of curd should be examined from time to time, to see that they are cooking on the inside as well as the outside.

CHAPTER VII.

DRAWING THE WHEY—DIPPING THE CURD.

As has been said, when there is an eighth of an inch of acid on the curd, the whey should be drawn off.

Measuring Acid. Strictly speaking, we cannot measure acid by the inch, but the acid seems to act on the curd in some way, so that when a piece is touched to a hot iron and drawn away, it will leave fine, silky threads behind, sticking to the iron. With normal working milk, when the curd is first cooked up, it will not string at all; but when the acid has reached a certain strength, it will begin to string, at first barely sticking to the iron, and as the acid increases, the strings will get longer, till they may be several inches in length.

Threads Due to Acid. That the threads are in no way due to the rennet, but are dependent on the acid, is shown when milk sours naturally. Such a sour milk curd will usually string on a hot iron. If acid is introduced into the milk in sufficient quantity to curdle it, the curd will likely string. In fact, strings of any desired length can be produced, by adding the right quantity of acid to the milk. However, if too much acid is added, it will make a soft, mushy curd, which will not string. In the natural curdling of milk, where the acid develops in sufficient quantity, we get just such a soft, mushy curd, that will not string.

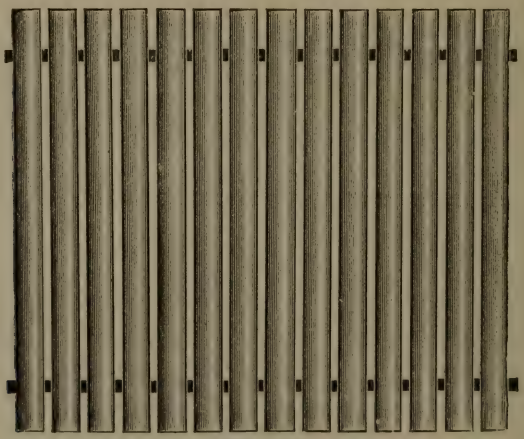
Result of too much Acid. Not only is this the result in cheese making, when too much acid is developed in the whey, but there is also a great loss of fat. Experience has taught us, that we cannot let the curd take more than one-eighth of an inch of acid in the whey without disastrous results. If we were to wait but a short time after we have strings an eighth of an inch long, we would find perhaps, that they had increased to an inch in length, and our curd would be ruined. It is therefore necessary, that one should work nimbly at this stage of the process. Not only should the whey be drawn off from the curd, but the curd must also be thoroughly drained, for whey in the curd will have the same effect as though the curd were still in the whey. Of course the curd must contain its natural amount of moisture, but there must be no pools of free whey in or on the curd.

In the old system of granular cheese-making, the curd was stirred over in the bottom of the vat, and then a ditch made in the middle for it to drain. In this stirring, considerable fat was lost, and the curds were not uniform in moisture. The reason of this was, that they were stirred drier one day than another.

Curd Rack. In the system distinctly known as the cheddar system, which we follow, the curd is drained on racks, which are placed either in the bottom of the vat or in a curd sink. The racks are made of hard wood, preferably maple. They are constructed of strips rounded on the top, three-fourths of an inch thick, two inches wide, screwed onto two other pieces two inches high, three-fourths of an inch thick, and four

feet long. The slats are three-eighths of an inch apart, and extend crosswise of the vat, and are long enough, so that not more than a quarter of an inch of space is left between each end and the sides of the vat. The racks are usually in two four-foot sections.

Racks, how Used. When the whey is drawn down, so that there is but very little whey left in the vat to interfere with operations, the vat is tipped so that one end is five or six inches lower than the other, and the curd is shoved down to the lower end till about five feet



CURD RACK.

of the upper end is cleared. The first section of the rack is then put in, and a linen strainer cloth thrown over it. This strainer cloth should be about twelve feet long, and wide enough (60 inches) to come up over the sides of the vat. The surplus cloth is then tucked under the lower end of the rack, and the curd piled onto it and broken apart to allow the whey to escape.

It should be stirred over several times, and then left

to mat evenly about six inches deep. The space, formerly occupied by the curd that has been put onto the racks, is now clear, and the second section of the rack can be placed in the vat. This is put in close to the first section, and the cloth that had been tucked out of the way, is drawn over it and covered with curd, care being taken, as on the first section, to stir out the whey. The sides and ends of the strainer cloth are then wrapped over the curd, and the vat covered with a heavy cloth cover to keep the curd warm. The temperature must be maintained, to keep fermentation going on.

Cutting the Curd Into Blocks. After ten or fifteen minutes, the curd will have matted together, and can be cut into large blocks, which are turned over. The best instrument for cutting the curd is a wooden butter spade, which will cut the curd but not the cloth. The curd can be cut once or twice down the length of the vat, and across the vat, into pieces eight inches wide.

Turning the Curd. Begin at the lower end to turn the curd, for it will be more convenient to place the hands under the curd on the side toward the upper end of the vat, and roll it over. In so doing, it is not necessary to lift the piece, thereby breaking it. Continue turning the other pieces in the same manner, till the last piece at the upper end of the vat is reached, then, by a pull of the cloth, it is turned over. Cover it up and let it stand to mat still closer. By using racks, the whey runs through when the curd is turned

over. Watch the curd, and if whey should collect between the pieces, turn them over and let it run off. The curd should be turned over from time to time, but much oftener at first, to facilitate the expulsion of the whey. After a while the curd will begin to get a grain to it, and will tear like the meat on a chicken's breast.

Pin-holey Curds. If we have what is called a "gassy" or "pin-holey" curd, the gas will begin to form in little holes about the size of a pin head. Through the flattening of the curd, these holes are flattened and the gas escapes. Sometimes these pin holes appear before the curd is taken out of the whey, and, if they are plentiful enough, the curd will float on the surface of the whey, and we have what is called a "floater." But this does not occur very often, if we draw the whey in time. It used to occur quite often with bad milk, when the curd was left in the granular form, and more acid was run in the whey. The pin holes were not flattened, and consequently appeared in the cheese. Such curds are often accompanied by a bad flavor. They are probably caused from bad ferments, but may be due to bad flavored food. Clover and watercress, when eaten by the cows, have been known to give a curd with pin holes.

Some of the taints are much more persistent than others. As a usual thing, a taint can not be gotten entirely out of the cheese.

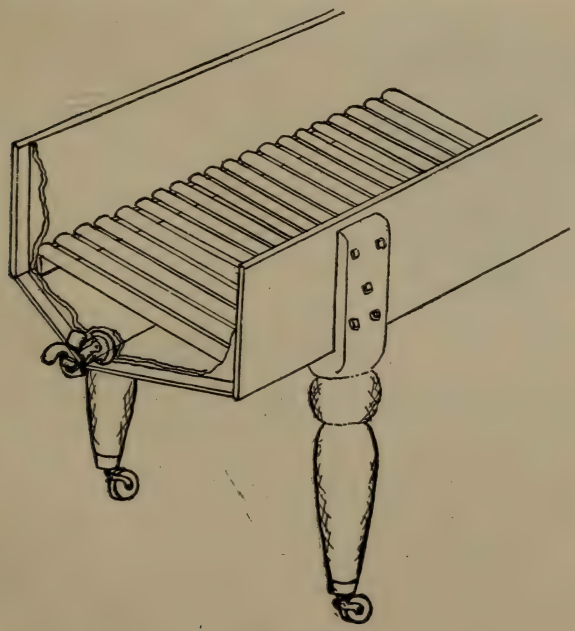
Washing Curds. A curd can be greatly improved by washing it. When put onto the racks, and before

it has had time to mat, a few pails of water at a temperature of 105° F. will wash out a great deal of the taint. Sometimes taints, due to the feeding of turnips, cabbages, and like foods are met with. In such cases, potassium nitrate, commonly called salt peter, has been used to prevent the flavor showing in the cheese.

CURD SCOOP.

I do not like the idea of using such things, as they are injurious to health. If foods like turnips are fed to cattle, they should be fed in small quantities just after milking, and the results will not show in the milk.

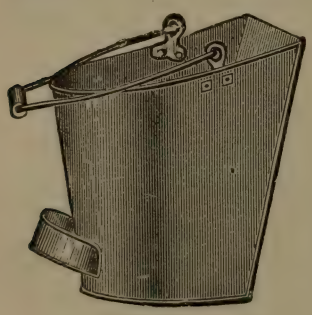
Use of a Curd Sink. It is much easier to get the curd onto the racks and expel the whey, by using a



CURD SINK.

curd sink. Nor is as much fat lost in the operation, for where the curd mats together in the vat before it can be gotten onto the racks, it is necessary to break it apart to let the whey out, and the necessary bruising forces the fat out of it.

Proper form of Curd Sink. The common form of curd sink, with an opening along the whole length of the bottom, is to be avoided. The sink should be a tin lined box with a channel bottom. There should be racks in it, and the channel under the racks will leave a place for hot water, to keep the curd warm. There should be a faucet at the lower end that can be opened to let the whey drain off, and then closed to keep the water under the curd. If the racks are not used, the curd will not drain sufficiently; and if there is an opening along the bottom, there will be a current of air started up around the curd which will be cooled. Of course this is just what we must avoid, because the fermentation will be checked, if the curd cools down.



CURD PAIL.

How to fill the Curd Sink. When the curd sink is used, the whey should be drawn down in the vat till it just barely covers the curd; for while it is covered with whey, it will not mat. The curd sink is then run to the lower end of the vat, and the curd dipped over onto the racks in the curd-sink. All the whey runs through, and the curd is left dry to mat properly.

If the curd is tainted, it can be more thoroughly washed, as the curd is not matted together, and the water will wash all around the particles. As the curd is filled into the sink, this can be moved along, and the curd filled into it evenly.

After the curd has been turned several times, the maker can begin piling it. He can pile it two, three, or five or six layers deep, but he should keep the pieces pretty well together, so that the curd will not spread too much at first.

Keep the Curd Warm. The pieces that have been on the outside of the pile should be placed on the inside, so that the temperature may be kept even. We must not forget the fact, that cheese-making is a process of fermentation, and that heat is a great factor in it.

Piling Curds. Piling the curd has a tendency to make a fast-curing, soft or "weak-bodied", cheese. If a fast-curing, soft cheese is desired, then the curd should be piled, but if a slow-curing, firm-bodied cheese is desired, we should pile the curd very little, or not at all. In many of the best Canadian factories, the curd is not piled at all, but is turned over and over. A curd, from over-ripe milk, should not be piled very much, as such a curd is likely to produce a "salvy" cheese.

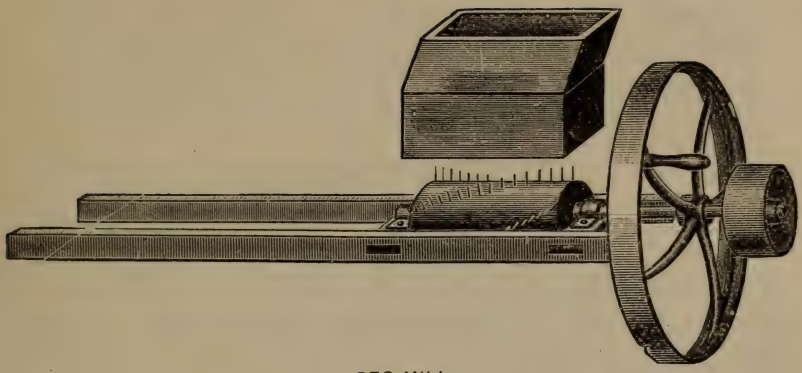
CHAPTER VIII.

MILLING THE CURD.

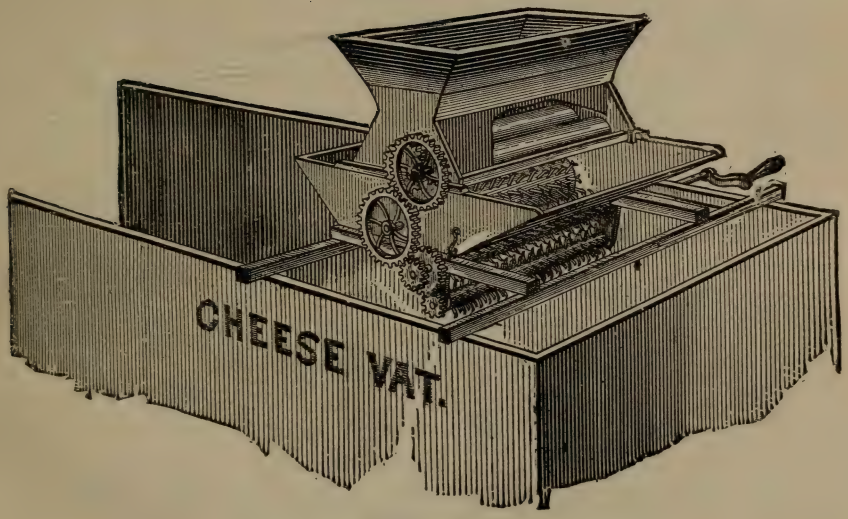
When a Curd is Ready to Mill. In the course of an hour and a half from the time the curd has been dipped onto the racks, it will have matted down, and assumed a meaty texture. It will not tear out in chunks, but in strips, like the meat on a chicken's breast. There will also probably be half an inch or more, likely an inch, of fine strings, when tried on a hot iron. It is then ready to grind or mill, that is, it is put into a curd mill and cut into small pieces. The acid should be developing well at this stage of the process, but the amount of acid is not so important as that the curd shall be meaty in texture.

Description of Curd Mills. The first curd mills were used in England. They consisted of a hopper, in the bottom of which was a roller with iron pegs in it. Sometimes there were two rollers. On the side of the hopper were iron pegs, and when the curd was thrown into it, the pegs in the roller would catch it, and carry it against the pegs, and tear and squeeze it to pieces.

The old Roe mill is made on this principle. The old Elgin mill was also on the same plan, only there was less room for the curd to get between the pegs, and the curd was badly smashed and jammed. It helped to get rid of the fat, and such a mill ought



PEG MILL.

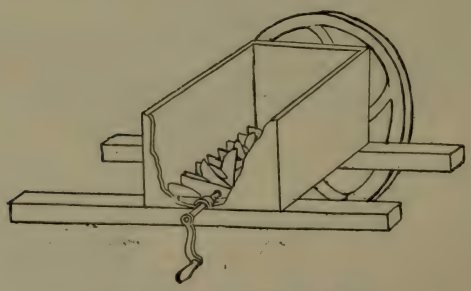


POHL MILL.

never to have been used. The curd mills got a bad reputation from such members of the family as the Elgin mill, and even to-day, it is hard to restore the decent members of the family, to the confidence of all cheese makers.

Pohl Mill. The next form of peg mill, which I think is the best peg mill ever invented, is the Pohl mill, which has sharp teeth on two cylinders, revolving at different velocities, which pick the curd to pieces. The objection to this mill is, that it does not leave the curd in the same sized pieces. Some of the pieces will be quite large, while others are small, and when salted, the salt will not be evenly distributed. There is a self-salting attachment to the mill, but it is useless, as a curd is never ready to salt when milled.

Whitlow Mill. A knife-mill does not jam the curd as much as a peg-mill does. It simply cuts it. One of the earliest forms of knife-mills was built

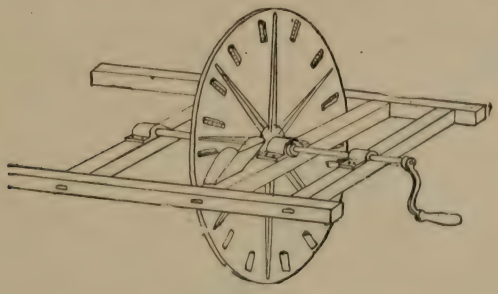


COMMON KNIFE CURD MILL.

after the form of peg-mills, as is seen in the Whitlow mill of Canada. There are a number of knives on a shaft which play between knives in the side of the hopper. When the curd is put into the hopper, it

is caught between the knives and cut into small pieces.

McPherson Mill. The McPherson mill, invented in Eastern Ontario, consists of a wheel with knives in it similar to the blade of a plane. A hopper feeds



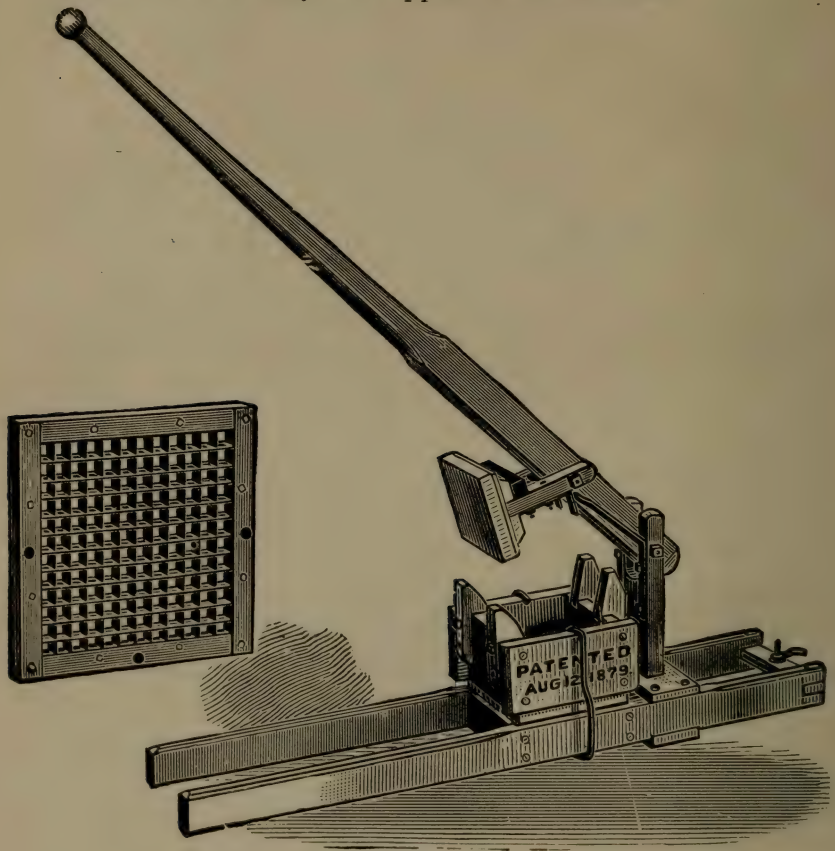
McPHERSON CURD MILL.

the curd down against the wheel, and as it turns, slices of curd are shaved off. The wheel is apt to make the curd fly.

The Harris Mill. The Harris mill has a network of knives at the bottom of a hopper. A plunger works by a lever into this hopper, and when a chunk of curd is dropped into this, the plunger forces it through the knives, leaving the curd in pieces one-half inch square, and as long as the piece of curd dropped into the hopper.

Caswell Mill. The Caswell mill used in Canada, is really a Harris mill fitted up for power, but instead of cutting the curd into square pieces, they are diamond-shaped. In either of these mills, the curd should be put into the hopper edgewise, so that the strips will be cut in the direction of the grain of the

curd. If there are any holes in the curd, the pieces lying across each other will continue to flatten them. The pin holes must be flattened, for as long as they remain round, they will appear in the cheese.



HARRIS CURD MILL.

Advantages and Objections to Knife Mills. The other advantage of a knife-mill, besides saving the fat in the curd, is that the curd will not mat together on the racks, but can easily be torn to pieces by hand. An

objection offered to such mills is, that the curd will not press together well. It may perhaps be difficult at times, but I think the trouble in closing the cheese lies somewhere else. It must be remembered that knife-mills are used, hardly without exception, in factories where the best Canadian cheese is made, and this cheese is shipped to England, where the bandages are often stripped off from them, and they must necessarily be closed.

If the trouble in closing the cheese be carefully investigated, I think it will be found to be in the bandage used, or the temperature of the curd. Some makers let the curd mat together again, and grind a second or third time, but I do not like so much hacking of the curd. The curd should be piled up to flatten the pin holes, and then stirred every fifteen minutes to give it air.

Stirring the Curd. A five tined fork, with the points turned into little loops to prevent catching into the cloth, or sticking into the sink, is a very handy tool with which to stir the curd. It does the work thoroughly, and with much less labor than with the hands alone.

Time to Mill. I like to have the grinding come about half way in time, from dipping the curd to salting it. It therefore should be an hour and a half from grinding to salting. During all this time the temperature should be kept up. (Why?)

We want a curd to take all the acid it will before salting, which is indicated by strings about two inches long on the hot iron.

Effect of Dry Acid. If a fast curing cheese is wanted, there is all the greater reason for giving it all the acid it will take.

If a cheese is salted before the lactic fermentation has proceeded far enough, Swiss holes will develop.

Do not be afraid of getting a sour cheese by giving it all the *dry* acid it will take. If you have got all the whey out of the curd, there is no danger from too much acid. It is acid in the whey that makes a sour cheese.

How to Expel Gas. If the pin-holes are not all flattened out by the time we are ready to salt the curd, it can be put into the hoops and pressed up for fifteen minutes. Then take it out and pull to pieces by hand or with the fork.

CHAPTER IX.

SALTING THE CURD.

Condition of a Curd for Salting. When ready to salt, the curd, when rubbed on the hot iron, should not smell like burnt hair, but like toasted cheese. It should not feel harsh, but soft and silky, and when squeezed in the hand, a mixture of half fat and half whey should run between the fingers.

If it is clear whey that runs out, the curd is not ready to salt. White whey should not run from a curd. It has not been fully freed from whey, and there is a heavy loss of fat. Of course, if the whey is in the curd, it should be gotten rid of, but it ought not to be there. When salted, a clear brine should run from the curd.

Few cheese-makers realize how important a step in the process of cheese-making, the salting of the curd is, and they salt all their curds according to some fixed rule, learned from their predecessors, without knowing what the salt does.

What Salt is. Salt is known to chemists by the name of sodium chloride. It is a chemical combination of the metal sodium and chlorine gas, in the proportion by weight, of twenty-three parts sodium to thirty-five and a half parts chlorine.

Where Salt comes from. It occurs in beds in the earth, and is either mined, or more commonly obtained

from salt wells, in which the salt is dissolved by the water, pumped up to the surface, and evaporated, leaving the salt. But salt does not occur pure in these beds.

Impurities in Salt. There are associated with it potassium chloride, calcium chloride, sulphates, magnesia, and lime. The presence of calcium chloride in the salt makes it lumpy and damp, for calcium chloride has a great attraction for water, and will take it from the air. Calcium chloride and magnesium give the salt a bitter taste.

These impurities however, as well as the water contained in salt, are a very low percentage of the whole, and when a salt dealer talks about his salt being so much stronger or purer, than any other high grade salt, it is not so. Do not understand however, that common barrel salt is just as good as the best salt for cheese making, for it is not. Common barrel salt contains a great deal of dirt, and salt may take up bad odors, which will be imparted to the cheese.

Fine salt that has probably been ground, and the crystals broken, will dissolve faster than a coarser salt, in the natural crystalline form.

Salts can easily be tested as to quality, by dissolving them in pure water, in a glass cylinder, and shaking up to dissolve. Use more salt than will dissolve. The best salt is that which leaves a clear brine with no scum of dirt on the top, nor dirt in the bottom of the solutions.

What Salt does to Cheese. In the first place, salt gives taste to a cheese. A cheese without salt has an

insipid fresh taste. Salt also takes out the moisture, so that fermentation is checked. A cheese without salt will cure very fast, in fact fermentation goes on so rapidly that gas holes are formed.

The same thing is seen in brick and Swiss cheese, in which the fermentation starts in the unsalted state, but the salt, which is applied to the outsides, works its way into the cheese, before it gets bad. It should be noted, that such cheese has to be cured in a cellar, where there is a constant low temperature. They would otherwise spoil.

Effect of too much Salt. If a cheese is salted too heavy, it becomes dry and mealy, and cures very slowly. The flavor is also injured. If we have bad milk, we should salt higher to improve the flavor, for up to a certain point, this is accomplished by heavier salting. I believe this to be due to the fact, that as the fermentation is checked by more salt, the gases formed have a chance to diffuse, and get out of the cheese without filling it with holes and the odor of the gases.

We would, therefore, if we wanted to make a fine flavored cheese, salt it pretty heavy, say three pounds of salt per one hundred of curd. We must expect however, that such a curd will cure slowly. We cannot make the best kind of cheese in a day, a week, nor a month. If one wants a fast curing cheese, he uses more rennet and less salt, but the product will not be as good a cheese. It will not be as close, nor as fine flavored, for the gases will not have had time to escape from the cheese. If one is making a fine, slow

curing cheese, he need not expect to get as much cheese per hundred weight of milk, as if he were making fast curing cheese, for the salt expels the moisture and leaves less weight.

In a case which we had in the Wisconsin dairy school, a curd was divided into three equal parts. The first lot received no salt; the second lot one and a half pounds of salt per cwt.; and the third lot three pounds per cwt. The curds were then pressed separately, and the green cheese weighed as follows:

The cheese with no salt..... 10 lbs.
The cheese with one and a half lbs. of salt 9.75lbs.
The cheese with three pounds of salt..... 9.50lbs.

As the cheese cured, they kept their relative weights. Other experiments have borne out this result.

Curds not always Salted the same Amount. But curds should not always be salted at the same rate, from day to day.

A moist curd needs more salt than a dry one, for two reasons: First, the excess of moisture must be expelled by the addition of salt; and second, as the expulsion of moisture takes salt with it in solution, enough must be applied, to leave the proper amount in the cheese.

Salt should be Evenly Distributed. It is also essential, that the salt should be evenly distributed through the cheese. If there is too much salt in the curd that is put into the hoop last, it will crack the rind of the cheese.

Application of Salt. The curd should be spread out evenly in the curd sink, and a part of the salt scattered evenly over it. The curd should then be stirred thoroughly, and again spread out, and the remainder of the salt applied. It ought to be stirred every ten minutes, to keep the salt from settling to the bottom of the pile, in a brine.

Temperature for Salting. Before salting, it should have been cooled to 90° F., for if too warm, the fat may be expelled in large quantities with the brine. The curd should not be put to press, till the salt has been thoroughly dissolved and worked into it.

Condition of Salted Curd for Pressing. It has a harsh feeling, due to the undissolved salt crystals, and the outside of the pieces of curd are hardened, so that they will not press together readily; but as the salt works into the curd, it regains its velvety feeling. When this condition has been reached, it is ready for the press.

CHAPTER X.

PRESSING THE CHEESE.

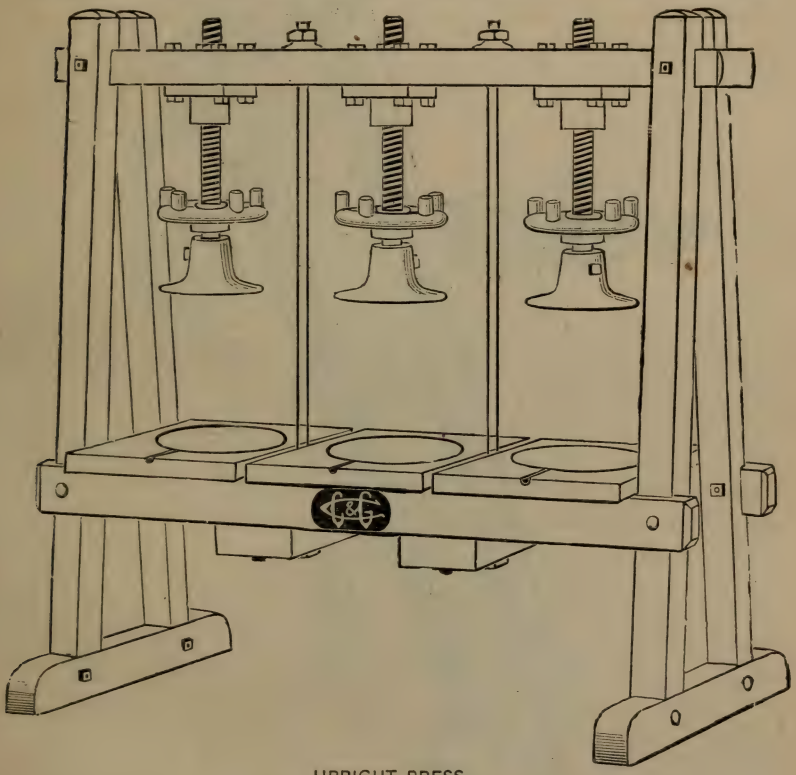
Curd Must Not be too Warm. Before pressing, the curd should be cooled to eighty degrees. If put to press warmer, the fat runs, and large quantities of it are lost. It also runs between the pieces of curd, so that they will not close together, and under the bandage, preventing it from sticking. Poorly closed cheese has often been blamed to the curd mill, when the trouble really lay in the temperature at which it was put to press.

Curd Must Not be too Cold. Of course, when the curd is much below 80°, it will not close together, but there is a happy medium. This happy medium varies according to the temperature of the press room. If the room is cold, the curd will cool down. A cheese-maker must have some brains in his head, and use them, for he is more than a mere machine to be wound up and run down. A proper temperature for the press room is about 70°.

Common Packages of Cheese. There are three common packages, into which American cheese is pressed, namely, Young Americas, weighing nine or ten pounds, Flats and Cheddars, weighing respectively thirty and sixty pounds.

The common diameter of flats or cheddar cheese is fourteen and a half inches, and a flat is half the height of a cheddar.

There are two kinds of presses used, the gang and the upright. The upright press has the screws in an upright position, and but one screw to a cheese. The gang press has one horizontal screw, which presses any where from one to twenty cheese. The hoops

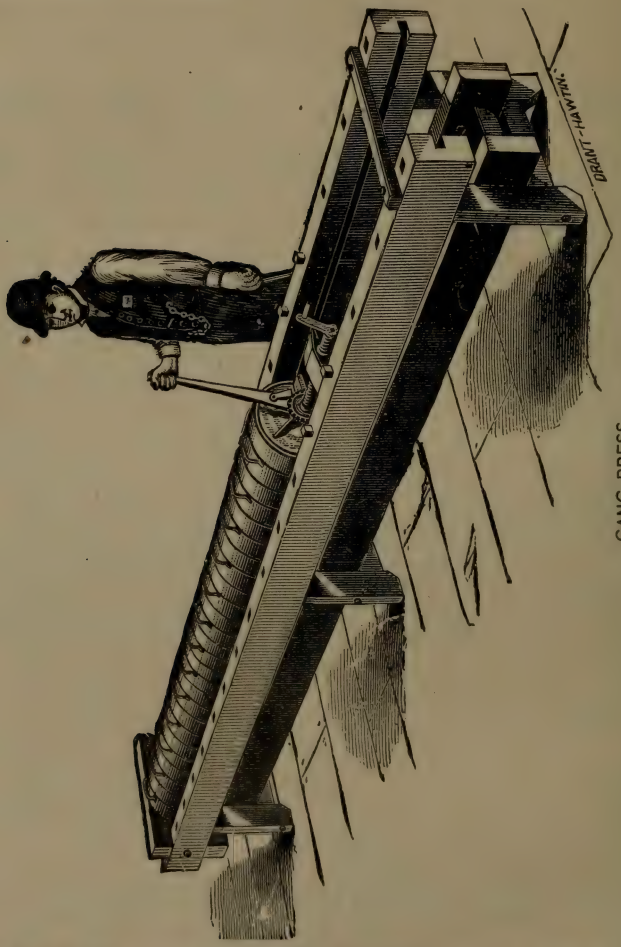


UPRIGHT PRESS.

are made a little smaller at the bottom than the top, so that each hoop will fit over the next one in front of it.

The Canadians use the upright presses more than we do in Wisconsin, thinking the pressure will be

kept up better, as there is but one cheese under a screw, but they are hard to keep clean and take up a great deal of room.



GANG PRESS.

There are forms of gang presses, which keep up a continuous pressure by springs, or a system of levers, which are kept tight by weights.

In the gang hoop, the bandage is held by an iron band, which slips into the top of the hoop. This iron band is called the "bandager."

In pressing the cheese, the maker should aim to turn out a perfect cheese. He should be an artist, and produce an object of beauty. The ends should be square with its height, clean, and the bandage turned down evenly at the ends, and closed well on the sides.

Kinds of Bandage Used. There are two kinds of bandages used, starched and seamless. The starched bandage is made up, from the starched cloth, by the factory man. The seamless bandage comes in the form of a long tube, from which the required length for the cheese is cut. But the starched bandage will not let the whey out properly, and consequently the cheese does not close on the sides. The cheese closes much better with the unstarched, seamless bandage.

How the Bandage is Put Onto the Cheese. When the bandage is put into the hoop, the edge should be turned in evenly, for about an inch and a half on the bottom, and perhaps dampened to hold its place.

Before putting the bandage in, the bottom cap cloth should be put in. It should be round, and as large as the bottom of the hoop (fourteen and a half inches), and should be soaked in hot water. Square cap cloths lap over onto the sides of the cheese, and make bad looking scars.

Cheese Must be the Same Size. Care should be taken to put the same amount of curd into each hoop, so that the cheese will all be the same height.

The hoops should not be filled so full, that the cheese comes above the junction between the bandage and the hoop, for in such cases, there will be a little ridge left at the junction, which will disfigure the cheese.

When the curd has been filled into the hoop, the top cap cloth is put on, and the fibrous ring laid around the edge, to keep the curd from pushing out, and then the follower put in. Usually the fibrous ring is tacked onto the follower, and while it may fit well, it quite often happens that it does not; and the curd will push out at the places where the ring does not come tight against the hoop. There is another point in having the fibrous ring separate from the follower, which will be noticed when we come to it later on.

Tighten the Press Slowly. After the hoops have been slipped into place, the screw should be tightened slowly, to let the whey out gradually. A small stream of brine should be kept flowing. If too great pressure is applied at first, the fat will be forced out. Curd closes together slowly, as will be seen by squeezing it in the hand. If it be squeezed suddenly, and then the pressure released, it will fall apart, but if pressed up slowly in the hand, it will stick together. We should not have reached the full pressure for about fifteen minutes.

In about an hour, the curd will be pressed together, and then the bandage should be turned down around the top of the cheese. This operation is generally called "dressing" the cheese.

Dressing the Cheese. Set the hoops in an upright position, and take out the followers, cap cloths, and

bandagers. Pull the bandage gently, to be sure there are no wrinkles in it, and then trim off evenly all around, so that it will lap over onto the end of the cheese about an inch and a half. Soak it down into position with warm water, and put on the cap, after having wrung it out in warm water. Be sure there are no wrinkles in the cap, for they will leave bad looking marks on the rind of the cheese.

Then put in the bandagers to keep the hoops straight in the press, and the fibrous ring and follower, and close up the press, putting on full pressure. Young Americas, however, will not stand as much pressure, for they do not have as much surface as larger cheese, to resist it.

How to get Cheese Dry. The idea, that we make a cheese dry by pressing it, is an erroneous one. The whey has to be gotten out of the curd, while it is in the vat, and if is not gotten out there, no amount of squeezing in the press will expel it, and the cheese will get sour.

If the press is not a continuous pressure one, as is likely the case, the maker should tighten the press the last thing at night, and the first thing in the morning.

In the morning, the cheese should be taken out of the hoops and examined, to see if they are perfect in shape, and all defects remedied. If the bandage does not stick, the cheese should be washed with warm water, and after being tightened in the press, hot water turned on to warm it up. If the edge of the upper end of the cheese is rough, it should be turned

end for end in the hoop. In either case, the fibrous ring should be left out, so that the edge of the cheese will come out of the hoop square. Of course it must be watched, to see that the cheese does not push out beyond the follower, and its last state be worse than the first; but if the pressure is carefully applied, a nice square edge can be put onto a cheese, in this way.

Do not Pound the Hoops. The cheese should slip out of the hoop with very little pounding. Pounding loosens the rivets, and thereby gets the hoops into bad repair, as well as loosens the bandage on the cheese, and sometimes breaks the cheese.

Where a knife is used to loosen the cheese, the bandage is also often loosened. If the cheese does not slip out easily, grease the hoops. The hoops should of course be kept clean, and if it is necessary to grease them, *clean* grease can be applied.

Cheese should never be taken out on the floor, but on a press board. We must remember that cheese is an article of human food. Most people like to have clean food to eat, and we should aim to be just as clean in making the cheese, as though the consumers were watching all the time.

Wipe the cheese off with a clean cloth, and then put them on the shelves, marking the date neatly. Cheese with great big marks scrawled ever them do not look attractive.

Greasing the Cheese. As soon as the rind has dried off, it should be greased with regular cheese grease. The practice of skimming the whey, after it

has fermented, and got full of dirt, is nothing less than a dirty trick. Good wholesome grease, prepared for the purpose, can be bought of regular dealers in dairy supplies, and nothing else should be used.

Cracks in Cheese. If the cheese is left exposed to the air too long, before being greased, it will crack. Another cause of the rind cracking is too much acid in the whey. A high acid cheese will, as a rule, crack. A draft of air blowing over the cheese will also cause it to crack. This of course is caused by the air absorbing moisture from the rind. I think, that while the question of moisture in the curing of American cheese has gone almost unconsidered, we must pay more attention to it in the future.

Cheese in Cold Storage. Cheese held in cold storage are very likely to mould, which will work into the cracks, and for this reason buyers do not want cracked cheese. The rinds of high acid cheese, held in cold storage, will also begin to rot at the middle.

Sometimes the maker leaves the caps, or press cloths as they are sometimes called, on, until a few days before shipping, and then pulls them off and greases the rinds.

Sometimes salt sacks made out of heavy ducking are used for caps. This leaves a hard, but very rough rind, and if the cheese is held in cold storage, and mould grows on it, it is almost impossible to get the mould off, so that it looks well.

Cleaning Mouldy Cheese. Cheese that gets mouldy in cold storage, is put into a sink of hot water to

which a little ammonia has been added, and scrubbed with a brush. It is put on a shelf to drain and dry, and afterward boxed again.

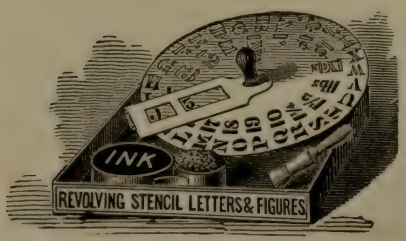
Cheese Cloth Circles. Sometimes a thin "cap" of cheese cloth, or a "cheese cloth circle," is put onto the end of the cheese.

Press Cloths. The first one is put on inside the "heavy cap" or "press cloth," before the curd is put into the hoop, and the other one is put in when the cheese is "dressed." The cheese cloth circle does not go on under the bandage, where it is turned down on the end, but over it. In using the circles, there is no need of cheese grease.

The circle makes the cheese much cleaner, and buyers generally prefer them, and will pay more money for the cheese, usually an eighth of a cent a pound more. The cost is about one-sixteenth of a cent a pound on flats.

They should be but twelve or thirteen inches in diameter, as they sometimes do not stick under the edge where they lap over the bandage.

Keep a Daily Record. When the cheese is ready to ship, it quite often happens that a maker finds something peculiar about a cheese, which he wishes to avoid or reproduce in the future, but he does not remember the circumstances connected with the making of that particular cheese. In the best Cana-



dian factories, a daily record is kept, in a book for the purpose, of how the milk and curd acts. This gives them a history of each cheese, and by its aid, they have often been able to remedy defects, and reproduce the better points.

Such a record is kept of all cheese made at the Wisconsin dairy school, only for greater convenience in the school the records are made by filling out printed blanks.

The following is a copy of one of the blanks:—

Date.....189

Vat used (Number of vat),
Condition of milk,
Per cent. of fat in milk,
Pounds of milk in vat,
Rennet test for ripeness,
Temperature set,
Time set,
Amount of rennet used,
Rate of rennet per 1,000 lbs of milk,
Time cut,
Minutes in curdling,
Time steam was turned on,
Time required in raising to.....degrees,
Hot iron test when dipped,
Time dipped,
Time from cutting to dipping,
Per cent. of fat in whey,
Time ground,
Hot iron test when ground,

Time salted,
Amount of salt on curd,
Rate of salt per 1,000 lbs of milk,
Time put to press,
Kind and number of cheese made,
Time dressed,
Time pressed,
Weight of green cheese,
Average weight of milk per pound of cheese,
Highest and lowest temperature of curing room for last twenty-four hours.

Remarks:—

Under the head of remarks, any important thing not included under the other heads may be noted, such as a gassy curd, or washing out the bad flavor, or any way of treatment differing from the ordinary way.

CHAPTER XI.

CURING OF THE CHEESE.

Proper Temperature. The curing of cheese is a process of fermentation, whereby the insoluble curd is converted into soluble peptones. Cheese is cured best at a temperature of 60°F. As has been stated before, at this temperature the gases have a chance to diffuse and pass from the cheese, without injuring its texture.

The curing room must therefore be so constructed, that the temperature may be kept constant at 60°. Cheese also needs plenty of fresh air, to make it cure properly and produce a good flavor. If a batch of cheese is divided into two lots, and one lot boxed up, while the other is placed on the shelves, it will be found that the lot in the boxes will cure slower, and be inferior in flavor to the lot on the shelves.

Oxygen Needed. Dr. Babcock in some work on the curing of cheese (published in First Annual Report of Cornell University Experiment Station), illustrated this still more fully, by curing cheese under bell-jars.

One cheese was fed pure oxygen, while the other was fed carbon dioxide (carbonicacid gas). The one receiving oxygen cured very rapidly and was fine flavored, while the one receiving carbon dioxide did not cure; and we thus see that fresh air is essential for the proper curing.

Curing Shelves, how Made. The cheese should be cured on shelves made of good clear pine, an inch and a half thick by sixteen inches wide, supported every four feet. The point in having the lumber clear is that sap and pitch will be in the knots and color the rinds. The boards should be wider than the cheese, for if the cheese projects over the edge, a mark will be left on the face of the cheese. The board ought to be heavy, and the supports close together, in order to prevent sagging, which might make the cheese, especially cheddars, crooked. The cheese should be turned every day, and the shelves wiped with a *clean* cloth. Pains should be taken not to soil the cheese nor break the corners in turning them.

Arrangement of Cheese. The older cheese should be kept on the lower shelves, and the younger ones on the upper shelves, because of the difference in temperature between the upper and lower portions of the room. The upper shelves being warmer, the younger will cure faster, and the month's make of cheese will be evener than if this rule were not followed.

Cheese ought to be kept till they are a month old before shipping. There is so much indigestible green cheese put on the market, that people get disgusted with it. If they could always get cheese such as they like, they would buy more, and if more cheese was bought, the price would be higher, and the farmer would receive a good rate of interest for waiting for his money.

CHAPTER XII.

SHIPPING THE CHEESE.

Cheese, how Boxed. Young Americas are shipped four, cheddars one, and flats generally two, in a box.

Where flats are shipped two in a box, they are placed one on top of the other, and are in that case termed "twins." When shipped one in a box, they are called "singles."

Scale Boards. That the rinds of the cheese may be well protected, "scale boards," or very thin basswood or whitewood boards, are placed in the box. Two or three are placed on each end of the box, and two or three between twins. This number is more than is generally used, but cheese in this way keep better when placed in cold storage. If flats are put together without scale boards, and left for any great length of time, they will stick together so tight that they can with difficulty be pulled apart. The rinds sweat and are easily broken. They therefore need plenty of scale boards. The boxes should be trimmed to one-eighth of an inch less than the height of the cheese, so that this will hold its place and arrive in market in good condition. They should not be more than a quarter of an inch larger in diameter than the cheese; if there is too much room in the box, the cheese will be likely to roll around and break the box. On the other hand, the box should not be so tight, that the cheese will stick in it.

Boxes that are split or poorly nailed should be thrown aside, for they will be sure to arrive in the market in a dilapidated condition. Cheese makers do not realize, that boxes that may be in *fair* condition, may be entirely useless at the other end of the journey.

Branding Cheese. Cheese made in several of our dairy States are required by law to be branded. According to the laws of Wisconsin, "full cream" cheese are those made from milk, from which no cream has been taken. Anything else is considered skimmed.

The dairy and food commissioner furnishes brands on application to him, and a file of the numbers of the brands issued is kept by him, in his office in the State Capitol at Madison.

The following is the law relating to the branding of cheese in Wisconsin:—

Dairy Laws of 1893.

No. 189 A.] [Published April 26, 1893.

CHAPTER 228.

AN ACT to regulate the branding of cheese.

The people of the state of Wisconsin, represented in senate and assembly, do enact as follows:

Section 1. No person shall offer for sale, sell, ship or consign cheese labeled with a false brand or label, as to the quality of the article.

Section 2. The state dairy and food commissioner is hereby authorized and directed to issue to the cheese manufactories of the state, upon proper application therefor and under such regulations as to the custody and use thereof as he may prescribe, a uniform stencil or brand, bearing a suitable device or motto and the words "Wisconsin Full Cream Cheese."

Section 3. Every brand issued shall be used upon the side of the cheese on the bandage thereof, also upon the package containing the

same, and shall bear a different number for each separate manufactory, and the commissioner shall keep a book in which shall be registered the name, location and number of each manufactory using the said brand, and the name or names of the persons at each manufactory, authorized to use the same.

Section 4. It shall be unlawful to use or permit such brand to be used upon any other than full cream cheese or package containing the same.

Section 5. Every person who shall at any cheese factory in the state manufacture skimmed cheese, shall distinctly and durably stamp upon each and every such cheese, and upon the box, the words: "Wisconsin Skimmed Cheese." All cheese not manufactured as in sections 1, 2, 3 and 4 of this act, shall be deemed to be skimmed cheese under the provisions of this act. The brand herein provided by this section of this act, for designating the grade and quality of cheese provided by this section, shall be such as to produce an impression not less than three inches in width and five inches in length, and shall be in full-faced capital letters of as large size as the space hereby provided for will permit, and the whole to be included within a plain heavy border. Ordinary stamping ink, either red, green or violet in color, and of such composition as not to be easily removed or wholly obliterated by moisture, shall be used in stamping as provided for by this section.

Section 6. Whoever violates the provisions of this act shall be deemed guilty of a misdemeanor, and for each and every package so falsely branded, or omitted to be branded as herein provided, shall be punished by a fine of not less than twenty-five nor more than fifty dollars, one half of which shall be paid to the person or persons furnishing the evidence upon which such conviction is made.

Section 7. All acts or parts of acts inconsistent with the provisions of this act, are hereby repealed.

Section 8. This act shall take effect and be in force from and after its publication.

Approved April 17, 1893.

How Cheese are Weighed. In weighing cheese nothing but full pounds are counted. For instance, if the weight is $60\frac{3}{4}$ pounds, it is counted but 60, or if the beam barely rises at 61 pounds, it is counted but 60, for in course of transportation, it would likely lose

weight, and be cut down, when it is in the hands of the buyer. In the large warehouses, where hundreds of boxes arrive in a single day, they can not stop to weigh every box; but weigh a few boxes, and if they fall short, the whole lot is docked accordingly. Such weighings are referred to an official weighmaster.

Marking of Weights. The weight should be stenciled, or plainly marked on the box (not the cover) next to the seam, where it can readily be found. A lead pencil hardly makes a sufficiently plain mark on a cheese box. The brand of the firm, to whom the cheese is shipped, should be stenciled on the side of the box.

Buyer's Stencil. The buyer generally furnishes a stencil for this purpose. Each stencil, so issued to a shipper, has a distinguishing number on it, which is recorded in the buyer's office, and by referring to the number they can tell who shipped the cheese. This is especially necessary, where several factories make up a car load of cheese for a firm.

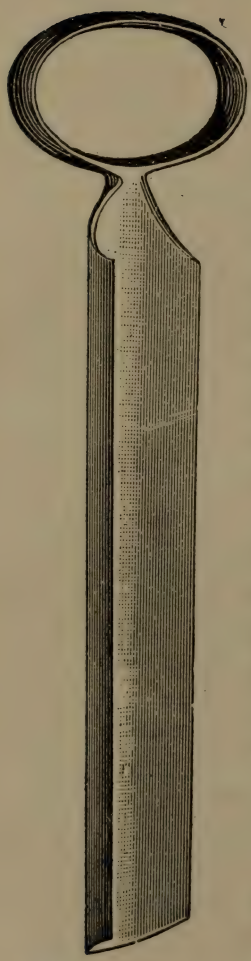
If a cheese-maker has any cheese that is not first-class, he should put a distinguishing mark on such and notify the buyer to that effect, and the buyer will usually deal fairly with him, for he understands that the maker is not trying to take advantage of him.

How to Sell Cheese. Cheese is sold mostly on the dairy boards of trade. The buyer, after he bargains for the cheese, should be required to inspect the cheese at the factory and accept or reject it. He should then give a draft on a local bank for the amount.

The bank then draws on the firm for the amount, at the place of business of the firm, and the cheese belongs to the bank till the draft is honored. This is a strictly cash basis, and is fair to both parties. When the cheese is hauled to the depot, the boxes should be covered with blankets, to protect it from the dust and the hot rays of the sun.

CHAPTER XIII.

JUDGING CHEESE.



Ideal Cheese. One trouble that cheese makers meet with is, that they do not have the proper idea of a perfect cheese in their minds. This arises largely from the circumstances under which they are placed. The cheese are shipped out of the factory as soon as the buyer will take them, the youngest being but a week or ten days old. The cheese may have defects, but the maker does not get a chance to see how it will turn out.

Cheese exhibited at the Wisconsin Dairymen's Conventions is scored according to the following scale:

Flavor	50
Texture	30
Salt	10
Color	10
Total	100

To try a cheese, a plug is pulled from it by means of a cheese trier. The trier should be thin, round, and a little tapering, so that it will pull a round smooth

plug. A plug should always be taken from the top of a cheese. Never plug it through the bandage.

Flavor. Flavor is the most important item in the quality of a cheese. No matter how good the other points may be, if the flavor is bad, the cheese will be condemned. It would be a difficult matter to describe accurately just what the flavor should be like, for there are different flavors in cheese, which may be equally good. This comes about from the different ferments in the cheese, which we cannot as yet entirely control. In another five years, bacteriological research will probably overcome this difficulty for us.

The old saying, that "the proof of the pudding is in the eating of it," is true of cheese. If it tastes good and we want more of it, it is just the flavor we should have. It should not be sharp so that it will bite the tongue, but of a mild lasting taste. A great many cheese, in which the flavor cannot be termed bad, are still on the negative side; they do not have that fine lasting aroma, although we can eat them quite agreeably, but do not feel that it is a matter of very great importance, whether we can have more of the same or not.

Where experts are judging cheese, they seldom taste of any. They get the flavor simply by the smell, for if they tasted of every plug, they would soon be confused as to flavor.

If a cheese is cold, it should first be warmed up in the fingers, before looking for the flavor.

Texture. While flavor stands first in importance, the texture of a cheese comes next. The plug

should be smooth, not fuzzy. If the cheese is not fully cured, the plug should bend a little before breaking. When held between the eye and the light, it should be slightly translucent. If the light does not come through it, it is a sign that the texture has been injured in the manufacture, probably by too high acid. When a piece is broken from the plug, it should not crumble off, but should show a surface such as flint does when broken, and is therefore termed a "flinty break." When pressed between the fingers, it should not stick to them, but should mould like wax. Cheese that is tough, and will not come down readily between the fingers, is said to be "corky," and is probably due to over cooking, or insufficient quantity of rennet to cure it properly. Cheese should not be mealy, as is the case with high acid or too highly salted cheese.

A cheese with good texture should not have any round, smooth, or ragged holes in it; but should be as solid as a board.

Cheese with the round holes, or one that is soft and pasty, will go off flavor on further keeping.

Salt. As was said under the subject of salting the curd, salt gives flavor to a cheese. In fact, the whole subject of flavor is affected by the salt. Cheese that are a little soft and a little inferior in flavor could have been entirely remedied, by using a little more salt. It has also been stated, that salt may injure both the texture and flavor by using too much. The influence of salt is, therefore, partly considered under texture and flavor.

Color. Like salt, the color of a cheese really is another way of judging its texture and flavor. A cheese without any coloring matter added to it, is improperly termed "white." An uncolored cheese should never be white, but of an *amber* color. If it is a dead white, it is so because the acid has cut the color out of it. Of course in a colored cheese, these things would be more easily seen.

The color should be even from one end of the plug to the other. A high acid cheese will give a distinct odor to the trier, the same as when acid attacks steel.

Gross Appearance. A good judge can usually tell the quality of a cheese from the outside appearance. It should be square, and the rind without cracks, for cracks indicate high acid. When the fingers are run over the surface, it should be springy, that is, it should give readily under the pressure and regain its position. If the finger sinks into a place which does not spring back, it indicates a hole or soft place in the cheese. The rind should not have any white spots on it, as these indicate whey. Sometimes the white spots will disappear in time, but it is a weak point in the quality of the cheese. When the plug has been replaced in the cheese, the place should be greased over, to keep the cheese from drying out, and skippers from getting into the same.

PART II.

Hints on the Construction and Operation of Cheese Factories.

CHAPTER I.

CONSTRUCTION OF FACTORIES.

One Difficulty in Making Good Cheese. A large part of the difficulty experienced in the making of good cheese, results from the condition of the factories. In order that we may overcome these difficulties, let us look at the factories and see where they are wrong in their construction, and then we will be in a position to suggest a remedy.

Too Many Small Factories. In the first place, there are too many small factories in which little milk is received, and in which too low a price for making is charged, and therefore the owners cannot afford to build properly equipped factories. In the older cheese manufacturing districts, the tendency has been to build a little shanty on every cross-road; people are beginning to see the folly of this, however, and I believe the tide is turning toward larger and better equipped factories.

Poor Buildings. A great many of the buildings are little more than one thickness of boards. The vat room is small, and in hot weather, the temperature

STUDENTS TESTING MILK — WISCONSIN DAIRY SCHOOL.

of the curing room cannot be held down to the proper point, while in cold weather, both the vat and curing rooms get down nearly to the freezing point; in fact the cheese may freeze in the hoops.

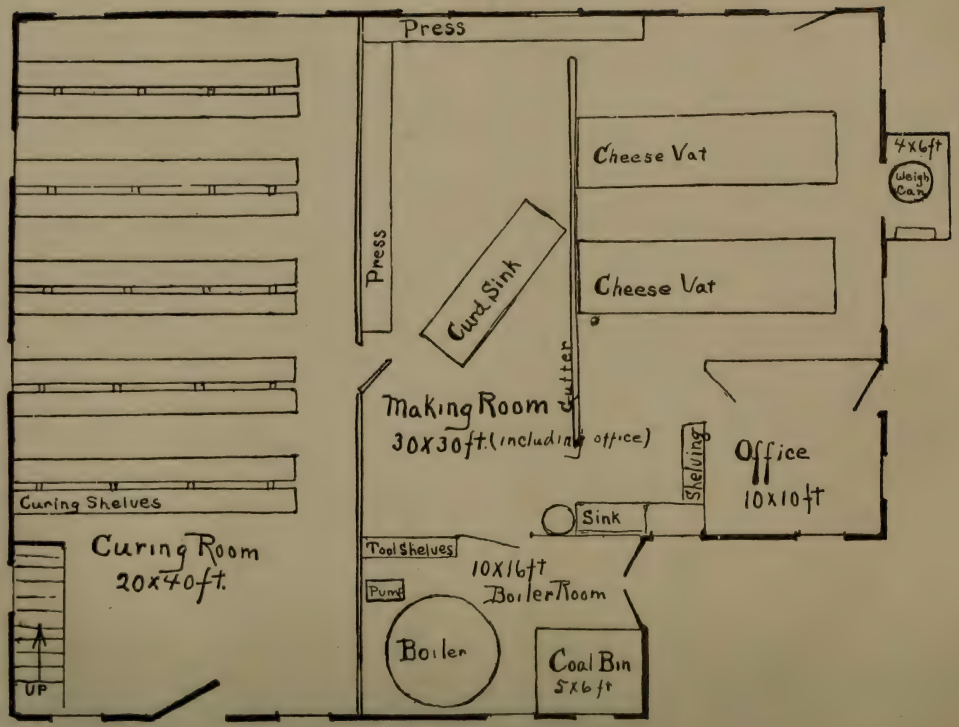
Poor Foundations. The floors are light and poorly supported. Whey is run onto the floor, and running through, forms a bad mud hole under the factory on account of imperfect drainage.

Whey Tank. The whey tank is set down in the ground where it cannot be cleaned out, and it is allowed to rot week after week, and contaminate the milk cans in which the whey is returned to the farms. It has even happened that horses have been scared, and ran away on account of the smell around a factory!

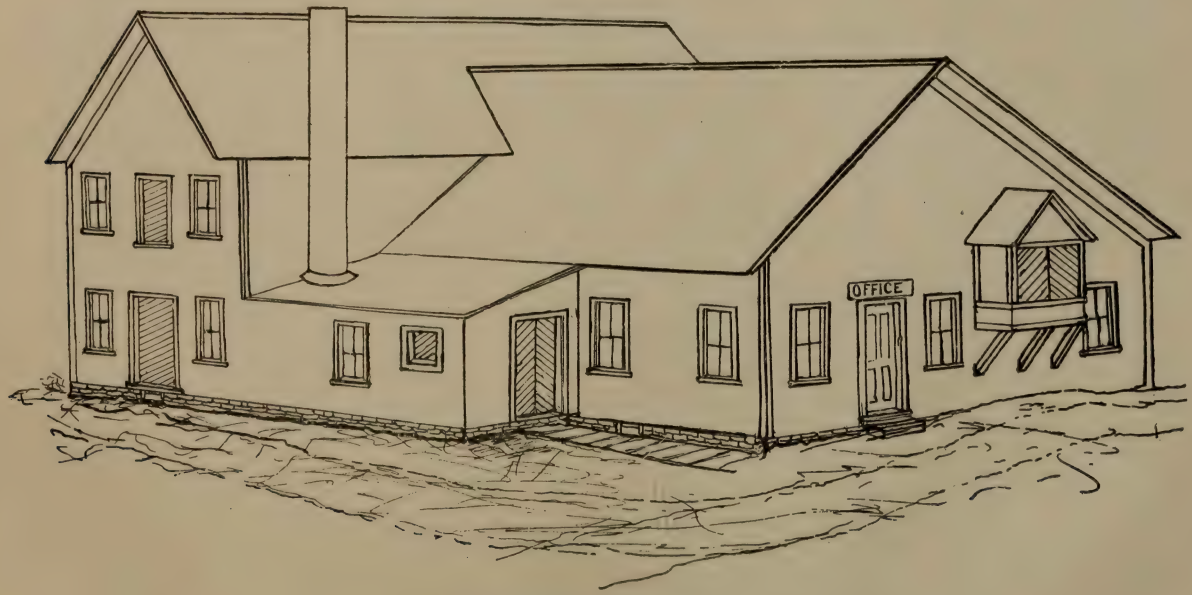
No Hot Water. In many factories there is no steam, but the milk is worked up in self-heating vats, and there is never water hot enough to scald out utensils, or even melt the grease off from them. Nor is there a sink for washing tools, and clean wash rags and towels are often lacking.

Any one who knows about our factories would, I think, say, that probably one half of them, would answer to this description. A great many persons do not like to admit that it is so, but we should never turn away from the truth, even if it does look dark, for unless we know the true condition, we cannot have a proper basis for improvement.

It is for this purpose that we have drawn this picture, that we may know how to remedy our mistakes.



GROUND PLAN FOR CHEESE FACTORY.



ELEVATION OF CHEESE FACTORY.

We will therefore consider how a factory may be properly built and equipped.

We will equip the factory for ten thousand pounds of milk per day, which I think is small enough.

Ontario Cheese-factories. One secret of Western Ontario's success is in the fact that her factories are large, well built, and properly equipped.

On pages 78 and 79 we give the plans for a factory.

Good Foundations. In the first place, we should get good solid foundations, either of stone piers, or gas pipe, which allows the ground to heave and settle, without raising or lowering the building. The supports should be close enough together to hold the sills in place.

Dimensions. Our plans call for a making room 20 x 30 feet, with an office ten feet square taken out of one corner of it, and a boiler room 10 x 16 feet attached, and a curing house 20 x 40 feet, two stories high.

Store Room. The upper story should never be used for curing cheese, but for storing cheese boxes and other supplies.

Curing Room. Some Canadian factories have the curing house separate from the rest of the factory, but we can build them together and save the lumber for a second wall, which would be necessary if they were separated.

Sills. We should have 8 x 12 inch sills around the outside of both parts of the building. There should

be two 6 x 8 inch stringers, running across the make-room, and one of the same dimensions running through the middle of the long way of the curing-room. We can put ten foot joists between the sills and stringers. The dimensions of these joists should be 2 x 10 inches, and they can be placed eighteen inches apart.

Curing-Room Floor. The joists under the curing room should have rough boards nailed close together on the under side, and a five inch layer of tan-bark put in between them. There will then be a five-inch space left above the tan-bark, over which a tight, heavy floor, is to be laid. This may be made, by first laying rough boards, and covering with paper, and then laying the regular flooring. The tan-bark, air space, and tight floor, are to protect from outside temperature.

Vat-room Floor. The making room should have a heavy two-inch floor, preferably of maple. It must slope at a scale of one inch in five feet, toward a ditch at the lower end of the vats, or twenty feet from the front end of the room.

Paper can be put on the studding under the siding, and the walls lathed and plastered. The studding is of 2x4, such as is generally used, and if tan-bark can be easily obtained, it can be filled in between the studding. Tan-bark is better than saw-dust for filling in such places, as mice are not inclined to work in it as much. It is hardly necessary to say, that the top of the room should either be ceiled or plastered.

Curing-Room Walls. The curing room must practically be a large box, with walls so constructed, that the temperature inside will be affected as little as possible by the temperature outside; some means of introducing cool, fresh air, into the curing room, is highly desirable.

The walls and ceilings will therefore have to be of several thicknesses, with air spaces between, like the floor which we have already described.

Doors and Windows. We must not forget, after we have built such walls, to have the windows fit tight and have shutters on the outside. The doors must be heavy, with air spaces in them, and close tight with a lever latch like a refrigerator door.

To construct our walls, we may put up our 2 x 4 studding two feet apart, which is to be lathed and plastered inside. On the outside, rough boards and paper may be put, and then another row of studding, and paper nailed on with boards on the outside of these. In the spaces in the outer row of studding, tan bark may be filled in.

Joists. The joists in the ceiling should be 2 x 6, ten feet long, eighteen inches apart, supported by 4 x 6 running crosswise of the room. If the room is ceiled overhead, tan-bark three inches deep can be filled in between the joists, and then a layer of paper put down before the floor is laid. If the room is lathed and plastered, boards must be put in to hold the tan-bark. The second story, which is used only as a store room, need not have double walls. A tight

fitting trap door should be made between the store room above and the curing room below, through which to get the cheese boxes down.

Stone Cellar. A better wall for the curing room in first story may be made of stone, and built into the side of a hill, for still greater protection from outside temperatures, as is the case with cellars for curing of brick and Swiss cheese. The stone and earth help to keep down the temperature of the air in the room.

Sub-Earth Ducts. But if a sub-earth duct be used, the first mentioned form of wall will be sufficient. A sub-earth duct is, as its name implies, an underground air duct. At about twelve feet below the surface, the ground maintains a constant temperature, of something like 50°F., and if we have a duct long enough, the air drawn through it will be cooled to near the temperature of the ground. Now if we have such a duct, say twenty inches in diameter and six hundred feet long, we can ventilate the room with cool fresh air. Without this duct, we would have to ventilate the room by opening the windows in the cool part of the day, and keeping them tightly closed when the air outside was too warm.

In order to start a current of air through an air duct, we must first build a fire in the chimney, and start a draft of warm air up the chimney. This will soon rarefy the air in the room, so that the air in the duct will start to fill up the space.

Regulating the Air Supply. We can regulate the temperature by having a register over the duct, and admit the air as fast as we want it.

Tube, how Built. The tube, of course, might fill up by the water in the ground running into it, if the ground at both ends was higher than the other part, or it might run into the factory if that end were lower, but we can obviate all this difficulty by making it slope the other way.

Boiler room. The boiler room should have a cement floor laid on the ground, and it should be lined with corrugated sheet iron, to insure against fire.

Building should be Raised. The rest of the building should be raised about a foot above the ground, so that air may circulate beneath and keep the sills from rotting.

Water Supply. A good well is an absolute necessity for a cheese factory; water can be pumped into a galvanized iron cistern placed above the curing room. This cistern should be set in a drip pan, which will catch any leak or sweat from it, and carry it outside without leaking through into the curing room.

Hot Water. From the cistern, water may be carried in pipes to the different parts of the building. The water pipes should be galvanized. There can be a steam pipe running into the water pipe by a T, and the flowing water can be heated by turning steam into it.

Sewer. In connection with the factory, there should be what is forgotten in nearly every factory, namely, a proper sewerage system. There should be regular six-inch sewer pipe underground, leading to a stream or blind-well, to convey the slops from the building.

In locating a factory, farmers figure on the handiest place for them to haul their milk to, but usually do not at all consider the sewerage question.

Blind-well. If there is no stream handy, the blind-well may have to be used. A blind-well, as one would surmise from the name, is a covered hole, into which the slops are run and absorbed by the ground. Care should be taken not to locate too near the water well, as the slops will in such cases percolate through the soil to the water supply. The danger from this source is greater in cases of gravelly loose soils. There should be an opening to the surface of the ground, for gases will be generated and force their way back through the sewer pipe.

Sewer Trap. At the mouth of the sewer there should be a sewer trap, which is simply an S shaped pipe, in which water constantly stands, and keeps gas from coming up from the sewer.

Sewer in Clay Soils. In a clay soil, the slops will not be absorbed fast enough, and the sewer pipe will, in that case, have to divide into a number of forks to spread the material over the surface, or near the surface of the ground. The slops should, in that case, be carried six hundred feet away from the factory.

Whey Tank, How Built. The whey tank should be lined with galvanized iron, and be placed high enough for a wagon to drive under, and draw off the whey by simply opening a valve. The ground ought to be paved in such a way, that the drip will run off into the sewer.

Elevating Whey. To get the whey from the vat into the whey tank, it can be drawn into a box or barrel, and from there forced by a steam jet into the whey tank. The whey should be scalded to keep it sweet, and after the patrons have gone every morning, the tank should be scrubbed out, and steam turned into it to scald it out. There should be a platform around the tank, and steps leading up, so that a person can get into it easily.

Bath-room. One thing that a factory should have, though generally unthought of, is a bath-room. This can be placed above the curing room. A room, five by eight feet, can have a floor covered with galvanized iron, to catch any drip or slop, and a bath-tub put in. Hot and cold water can be connected with it, and a most desirable thing supplied.

CHAPTER II.

EQUIPMENT.

For a factory of the capacity we are building, we will need an eight horse power boiler. A horizontal brick arch boiler is preferable to a vertical one, as it will hold the heat better, and a person can more easily clean the flues.

There should be a good steam-pump, and possibly an engine, though that is not absolutely necessary. For ten thousand pounds of milk, we will need two vats of a capacity of 5,200 pounds; these ought to be provided with whey gates for emptying them.

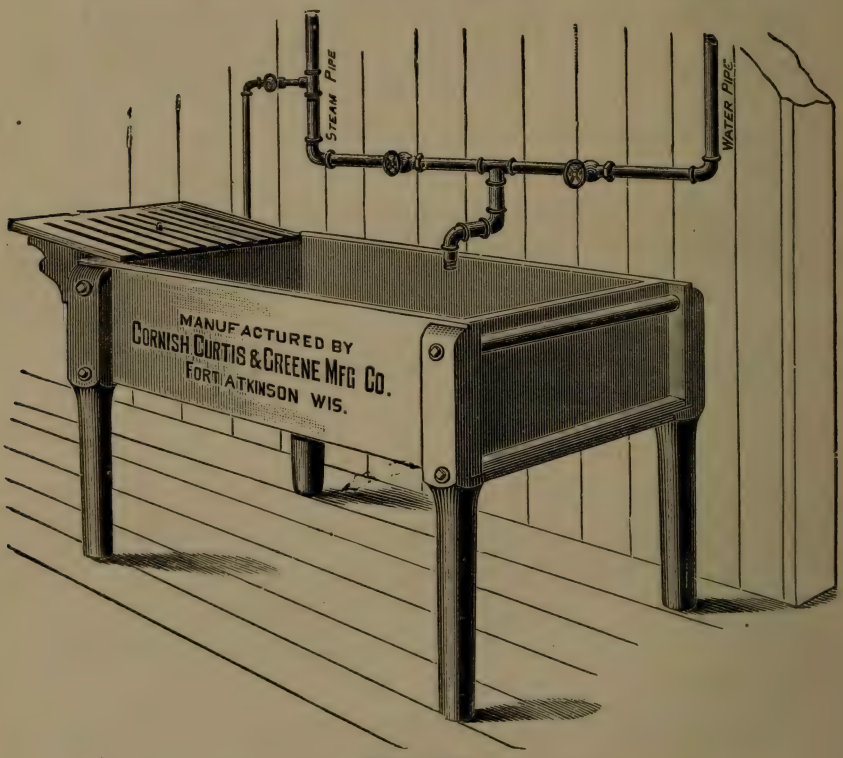
Water Boxes of Vats should be Lined. It is quite essential also, to have the water boxes of the vats lined with galvanized iron, or they will leak, making a bad mess on the floor.

Curd Sink. It will be remembered that we said in Part I, that a curd sink was a necessary piece of apparatus in getting the curd drained properly; we must therefore have a curd sink constructed in the way suggested. (See page 39.)

For the curd from 10,000 pounds of milk, two gang presses, and either twenty cheddar or forty flat hoops will be required. We should not attempt, as is quite commonly done, to press two flats in a cheddar hoop by putting a divider between. We cannot make an artistic looking cheese in that way.

Pressing Flats. Flat hoops do not cost near as much as they did a few years ago, and the expense will be but slightly increased in providing the necessary number of hoops.

Sink, How Made. Another necessary thing, which is seldom found in a factory, is a good sink. It should be



WASH SINK.

iron or galvanized iron lined, and plenty large enough —say three feet long, by twenty inches wide, by twelve inches deep, properly connected with the sewer. At the end of the sink, should be a wide shelf or table inclined toward the sink, so that drip-

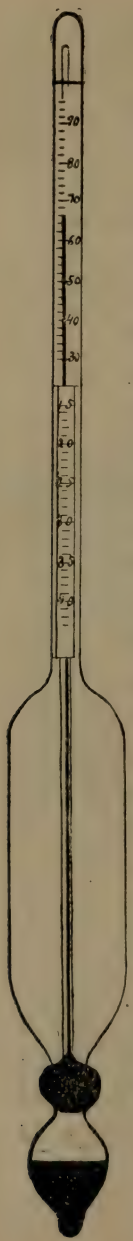
pings will run off into the sink. This shelf is used to drain tinware on, and a steam jet projecting through it, can be used to sterilize utensils.

We need hot and cold water connections at the sink, and perhaps a hot water barrel beside it. This barrel may be made of galvanized iron, and should be used for a supply of clean, hot water, *rather than a place to wash dirty tools.* This latter operation ought to be performed in the sink.

Milk, how Lifted. If the roadway is not high enough to empty the milk directly into the weigh-can, a large wheel fixed tight on an axle is probably the best appliance for lifting the milk. An endless rope runs over the wheel, and by pulling this rope, the wheel turns and winds up another rope on the axle. This rope has tongs on it, which take hold of the milk can.

The weigh-can is placed on an 800 lb. double beam scale, which stands in a receiving room or covered platform. This platform is built out on brackets in front of the factory. On one side of the room, is a shelf for the milk book, and another for the sample jars. The milk is run from the weigh-can to the vat, through an open tin conductor.

Milk Testing. For testing the milk, we should have a thirty-bottle, steam turbine, Babcock test, and a Quevenne lactometer. The Quevenne lactometer gives a direct reading of the specific gravity, and is used in connection with the Babcock fat test for detection of watered milk. The Babcock test is now used in most factories; and probably in one half of the factories, the milk is bought according to test.



That this is the only fair method of paying for milk, will be seen, for both the quantity and quality of the cheese made from the milk depend on its fat content.

Paying by Test. People often get confused about the justice of paying for milk, at cheese factories, according to the test. They think four per cent. milk ought to make a third more cheese, than three per cent. milk. They do not consider the question of quality. If their proposition were true, no cheese could be made from thin skim milk with no fat in it. The facts are, that about five pounds of cheese can be made from one hundred pounds of such skim milk, but the cheese can be sold with great difficulty, for one cent a pound, or five cents per hundred, after going to the trouble of making the cheese. The milk is worth more than that for feeding purposes, before touching it for cheese, to say nothing of the cost of making. Four per cent. milk will make ten pounds of cheese, that will sell for ten cents a pound, and one hundred pounds of four per cent. milk is worth one hundred cents. The skim milk made into cheese is worth five cents, or a difference of ninety-five cents for the fat. We have but five pounds more of cheese, but the difference in quality made by the fat is really the great difference.

Composite Samples. The samples should

be saved from each patron's milk every morning, by stirring up the milk in the weigh-can with a dipper. An ounce cup is then filled with the milk, and turned into the sample jar.

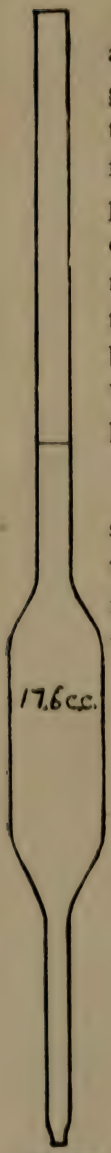
Sample Jars should be Marked to prevent Mistakes. Each jar has the number of the patron marked on it with asphalt paint, or in some other substantial way.

WEIGH CAN.

Milk Samples. How Preserved. A small quantity of potassium bichromate is put into the jar, before any milk is put into it, and this chemical will preserve the milk for a week or more. At the end of a week, the composite sample of each patron's milk is tested, and the reading of the Babcock test is the percentage of fat in the whole of the week's milk.

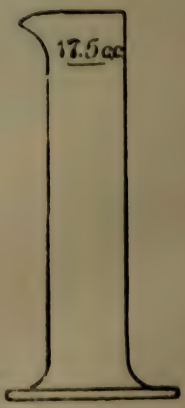
Babcock Test. For any person who is not acquainted with the Babcock test, we will give a brief description of it. As full descriptions of the test, and its application, have been fully published in bulletins and reports of experiment stations, and as this book treats more of cheese making than milk testing, and have not the room to spare, we will not go into details about the test, but refer the reader to bulletin 36, and the Ninth annual report of the Wisconsin Agriculture Experiment Station, if he desires to know more about it.

Appliances Needed. We will name over some of the minor articles needed in the factory, for some of them are usually found lacking, and sometimes there are not enough of the articles, to enable one to work handily.



PIPETTE.

BABCOCK MILK TESTING MACHINE.



ACID MEASURE.

There ought to be two curd knives—horizontal and perpendicular—and they should be six or eight inches wide, and twenty inches long.

TEST BOTTLE.

We need a rennet test, and *two or three* reliable thermometers, for these are easily broken, and we must not run the risk of being without one.

CONDUCTOR HEAD.

We will also need a hair sieve, linen strainer cloth, wash-dish, two curd pails, three or four twelve-quart tin pails, several dippers, one of which has a flat side, and a perforated-tin bottom, for skimming specks off from the milk.

Curing Shelves. The shelves in the curing room are supported by cross pieces, attached to wooden posts. These posts are 4×4's, reaching from floor to ceiling. The cross pieces are 2×4's, set into the 4×4, to keep them from tilting, and a bolt put through to hold them in place. The shelves are sixteen foot boards; sixteen inches wide, and one and a half inches thick. They should be the clearest pine lumber obtainable.

The shelving can run crosswise of the room, and if the boards are sixteen feet long, there will be a four foot passage on the side of the room next to the making room. At the further end of the room from the door to the making room, ten feet of space can be left for boxing cheese.

Cost of Factory. The factory we have suggested will cost more than the ordinary run of factories, for it is much better. Nothing that will be a waste of money, has been suggested. Certain firms put up factories which are inferior to this, for which they get a third more money than this would cost.

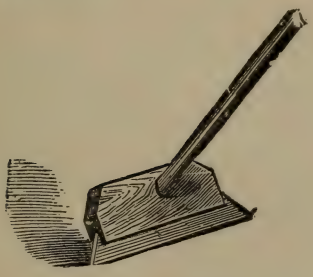
As the cost of material in different localities varies so much, we have not set a price on this factory, but the necessary facts are given, so that any one can figure on the cost of the building for his own locality, and then reliable firms will furnish machinery at reasonable prices.

CHAPTER III.

OPERATING A FACTORY.

Now that we have our factory in proper trim for working, a few suggestions about the methods of operating may not be out of place. We will not take up the process of making cheese, as this has been fully treated in Part I.

Keep Clean. Cleanliness is the main factor underlying the whole dairy business, and we must keep our factory clean. Almost every cheese-maker will keep the inside of the weigh-can and cheese vats clean, but the outside is often sorely neglected. Milk may be spilled on the floor, and not properly cleaned up. Water is slopped on the floor, and the maker wades through it without drying it up; when the whey is drawn from the vat, it often goes on the floor, and in order to keep his feet dry, he wears rubber boots.



Rubber Mop.

Rubber Boots. The rubber boots are an injury to his health and the slop unnecessary, to say nothing about the wear on the floor and its nasty appearance. We would think a woman who kept her kitchen floor in such condition, a very untidy housewife, and I see no reason why a factory floor should be slopped over any more than a kitchen floor. If any water accidentally gets onto the floor, it should be mopped up at once.

Scrubbing the Floor. At the close of the day's work, the floor can be scrubbed, first with lukewarm, and then with hot water, and then dried off with a rubber mop. Hot water will make the floor dry quickly, but it should never be used first where milk has been spilled, or where milk or whey is on tinware, for heat will scald the milk on.

Soaps. Powdered soap, such as "Gold Dust", is very effective in taking out dirt, but it is too expensive a form in which to use soap, as it dissolves readily and runs away. Salsoda is much cheaper and just as effective for a great many things, such as cleaning the floor. Sapolio is a soap mixed with infusorial earth, which may be used for scouring tinware.

FLOOR SCRUB.

Towels. Clean towels and clean cloths, for wiping utensils, are ornaments in a factory. Many a time has the writer been in a factory, and looked for a towel without finding even a dirty one.

Several good scrubbing brushes are needed in a factory, and one of them should be of rice root, for scrubbing cheese hoops and greasy articles.

In scrubbing the floor, the mop board should not be forgotten, nor the doors and other wood work. If the maker is careful in scrubbing the floor every day, a general scrubbing once a week will keep things looking bright.

Shelves for Trinkets. The windows should be kept as clean as those in a dwelling house, nor should tools and little trinkets be laid on the window-sills. There should be shelves for all such things.

The curing room should likewise be kept in order. It should not be a dumping place for all sorts of material, which properly goes into the store room above.

How to Kill Moulds. If at the beginning of the season, the walls are sprinkled with water, and the room closed tight while two or three pounds of sulphur is burned in it, moulds will be killed.

Antiseptics. A still better way is to wash the walls with limewater. Limewater is a disinfectant, and should be used wherever it can be applied. Commercial sulphate of iron, or copperas or green vitriol, as it is commonly called, is also a disinfectant, and should be put into drains and places that are likely to smell bad.

To Prevent Dust. The boiler room must not be neglected. If coal is used, coal dust can be prevented by sprinkling the coal with water. The floor should be kept cleanly swept, and should be mopped twice a week, or as often as needed. Tools should have their regular places and be kept there.

The reader may think it a waste of space to talk about all these little matters, but experience has taught the writer that they are the foundation of the business of cheese making; and makers often fail, because they do not recognize the fact.

It is much easier to keep a clean factory than a

dirty one, for the old saying that "an ounce of prevention is worth a pound of cure" is true here, as well as in other cases.

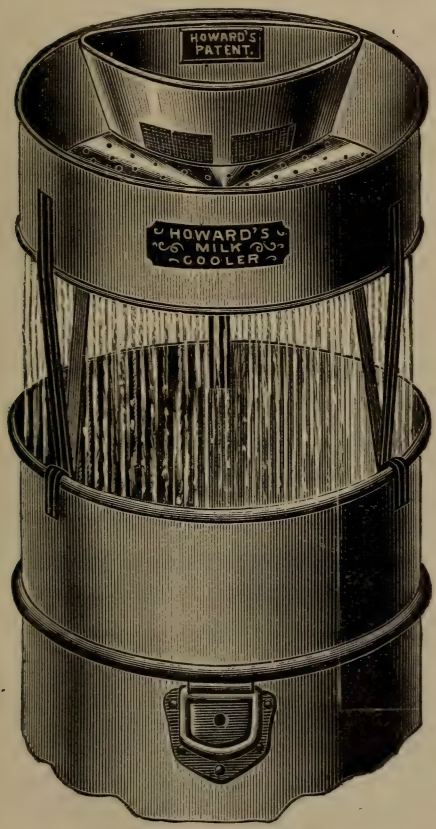
Factory Surroundings. Having got the inside of the factory clean, why not make the outside of it to match? Plant some trees, and in painting the factory, choose white or some light color, that will not absorb but reflect, the heat. A little extra effort may be put into graveling the roadways, to prevent them being cut up in wet weather. Level off the ground for a little space, seed it down, and cut the grass with a lawn-mower. If a dry spell comes, we have plenty of water in our well, and can sprinkle the lawn with our steam pump. These things would take but little extra effort, and I think all will agree, that the result would fully repay the effort.

Why should it not be the rule that a cheese factory is to be kept not only clean, but attractive as well?

CHAPTER IV.

THE MILK PRODUCER'S RESPONSIBILITY.

Aeration of Milk. During the last five years, the subject of aeration of milk has received a good deal of attention.



HOWARD'S AERATOR.

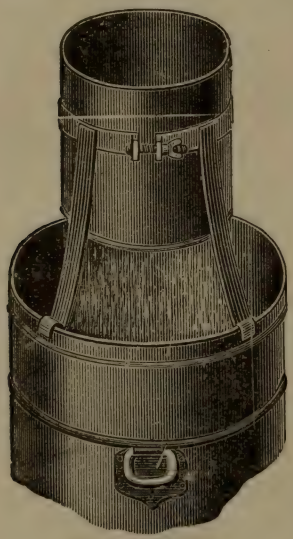
According to the old system of caring for milk, the patrons of a cheese factory were instructed to cool the milk as quickly as possible. Very often the milk was not properly cooled, and the milk would arrive at the factory sour.

We now hear cheese makers instructing their patrons to aerate their milk and not cool it, and many devices have been invented for this purpose.

Different Styles of Aerators. By aeration is meant, that the milk is thoroughly exposed to the air. This

may be done by pouring the milk with a large dipper, or allowing it to slowly trickle through small holes in a vessel, the fine streams of milk falling through the air into the milk can, or it may flow in a thin film over the surface of the apparatus, or air may be blown through the milk by means of an air pump.

What Aeration Does. By aerating the milk, animal odors and bad flavors escape. Of course the operation must be done in a sweet, clean atmosphere, or the milk will be inoculated with foul germs.



MILK AERATOR.

As a rule, milk that has been aired will keep sweet longer than milk that has not been aired, the conditions of temperature being the same, but the main advantage claimed for aeration is that the gases and bad odors escape, and the milk is better flavored.

In those factories where the patrons have practiced this, it has not been necessary to cool the milk, excepting for a few nights in the hottest weather. It is a safe rule, however, to have the milk a little too sweet than a little too sour, but in the fall, when the nights are cool, patrons are inclined to continue cooling the milk, the same as in hot weather, and the cheese-maker is obliged to wait till afternoon for his milk to ripen, or he will have "sweet-cheese."

Keep Barn Clean. The great cause of bad milk is dirt. The barn should be kept scrupulously clean, and lime water, and other antiseptics, freely used. The cows catch a multitude of germs in their hair while moving around in the grass, especially in swampy ground, and the germs fall into the milk at milking time.

Their bellies and udders should be washed, as well as the hands of the milkers, and if the milk vessels have been washed clean and scalded, there will be little danger of foul milk.

Old Milk Cans to be Discarded. Milk cans which have passed their days of usefulness, and become rusty and cracked, should be discarded, for they often spoil more milk than ten new cans would cost. Such old cans will be tinkered up by putting a double bottom on, or a patch over a hole, under which patch or bottom the milk will soon find its way and cause trouble.

Wooden Milking Pails Should Not be Used. It sometimes happens that wooden pails are used for milking in. The milk gets into the cells of the wood, and into the joints, and ferments, and no matter what precautions are taken, such pails cannot be kept clean.

Patrons Should be Educated. The patron has his share in the work of producing good cheese, by properly caring for the milk till it arrives at the factory, and while his intentions may be good, he is often unconscious of his errors, and the cheese-maker should endeavor to instruct him in the proper caring for milk.

PART III.

Questions for Aiding in a More Thorough Study of the Subjects Treated in Parts I and II.

The answers to these questions will be found on the pages indicated at the end of the questions.

MILK.

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4. How much ash is there in cow's milk? p. 1.
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